Welding Engineer

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DECEMBER, 1958

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Full Surface Cable Contact for maximum conductivity!

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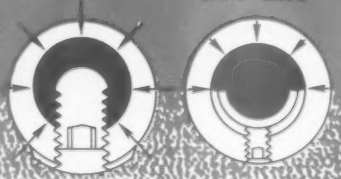

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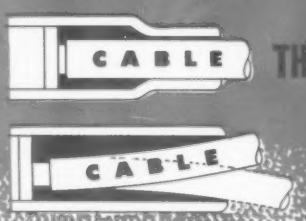

THIS **not this**

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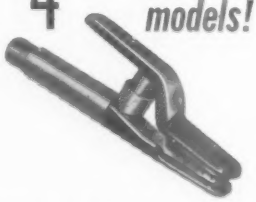

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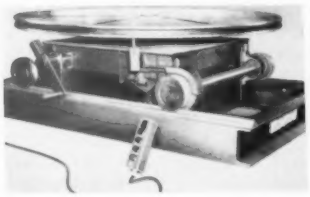
Vol. 43—No. 12

Welding Engineer

The magazine of joining and severing materials

This is welding: December, 1958



Machines for production 35
A special section devoted to welding's many assistants—the production machines which cut, bend, stamp or position parts to be welded or finish them after welding.

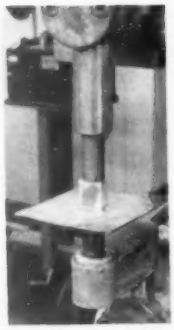
Tooling and welding team-up for economy 40
Gerald Garfield discusses how aircraft and missile manufacturers make good use of tooling and welding to gain required quality for their pressure vessels, plus a cost savings.

It's rugged . . . it's welded to handle industry's toughest tasks 44
From the customer's point of view, tractor-shovels must be able to carry enormous loads and yet move at a good speed. One manufacturer has solved this design problem through welding.

Fixture made to order 49
Clement F. Brown reports on tailor-made welding positioners and how one company used such a home-made fixture to weld a 10½-ft-long toothed shaft.

Contour welding with a magnetic-tape tracer system 50
Automation and welding continue to be an unbeatable team in the automobile industry. In this case, complex automobile frame side-rails and crossmembers are welded with a magnetic tracer.

Resistance welds will improve if you know your metals and electrodes 54
Concluding a two part series, **Lester F. Spencer** presents material standards for resistance-welding electrodes, as well as important information on the weldability of various metals.



New metal-blanking process offers labor and cost savings 60
Gregory Cannizzo reports on a new and patented method of metal-blanking which promises greater cost and labor savings over conventional dies.

Also in this issue:

English engineer wins 2nd Gregory award 43
A short history of the safety hat 52
Riding out the recession 63
Fast joint preparation on tubular members 64
44-year use by 2 generations 74

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Welding Engineer

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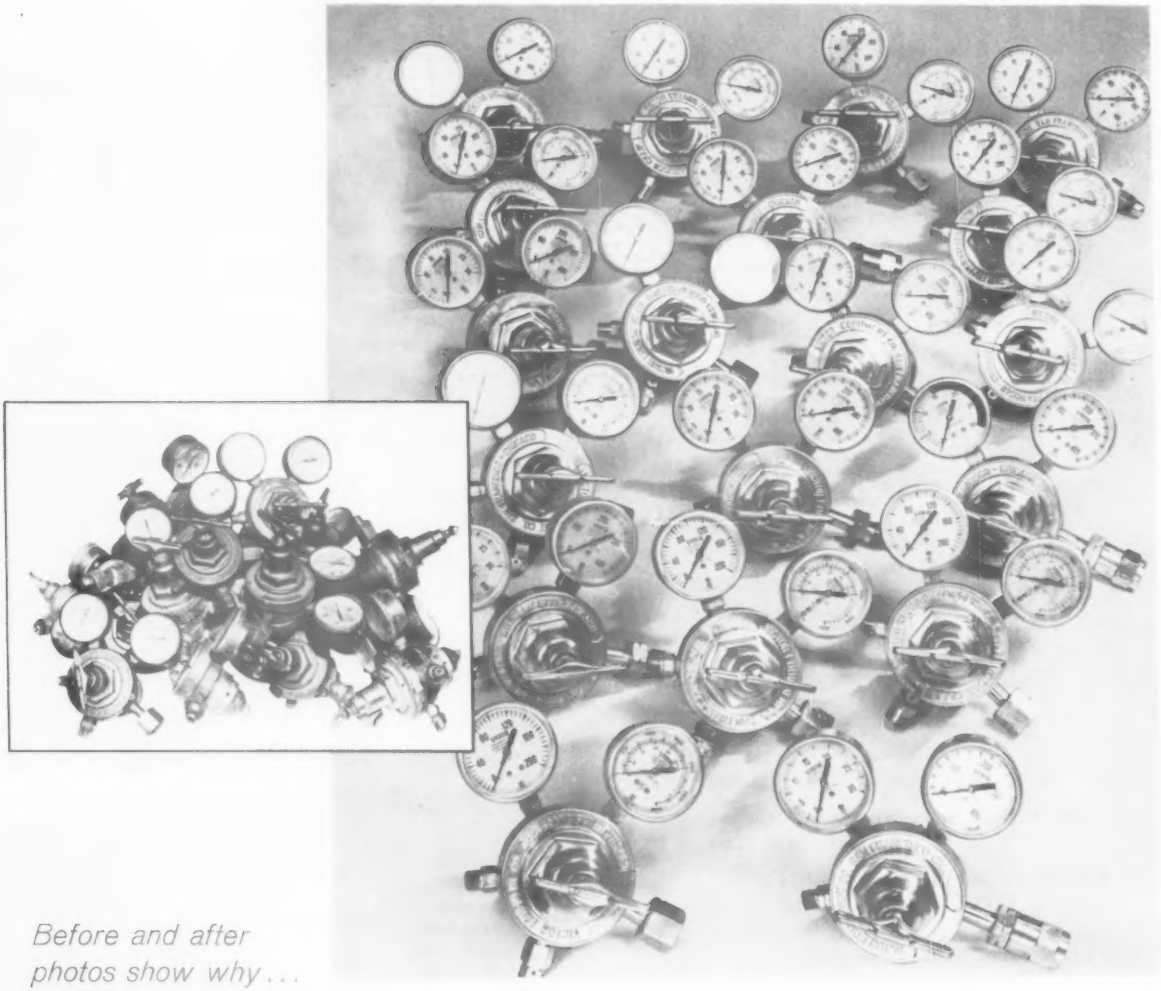

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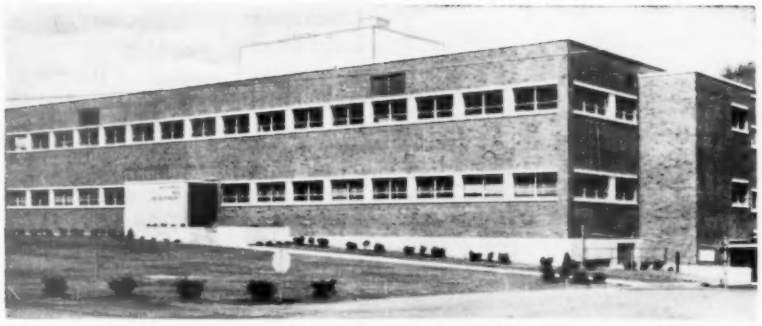

NEW Sylvania Electric Products Inc. 48,000 sq ft engineering, research and development building recently dedicated at Towanda, Pa. Advanced experimentation on high-temperature metals, semiconductor materials and phosphors will be conducted in the building.

Research laboratory dedicated by Sylvania

Sylvania Electric Products Inc., New York City, recently dedicated a 48,000 sq ft laboratory for research on high-temperature metals at its Chemical and Metallurgical Div., Towanda, Pa.

The new laboratory will also house research operations on engineering, product development in many areas of metallurgy, spectography and X-ray defraction.

Designed by the company's Facilities Planning Office at Williamsport, Pa., the research center includes engineering offices, laboratory and pilot plant facilities for more than 100 scientists, engineers and technicians. The building is dedicated to the memory of John B. Merrill, a former vice president of the company who was killed in an airplane crash in 1955.

Marion E. Pettigrew, a Sylvania vice president and director of the Metallurgical and Chemistry Div., spoke at the dedication. He discussed the heat problems that exist in jet propulsion, rocketry, missiles and satellites. He said the outcome of man's struggle with outer space depends on the ability of science and industry to develop abundant metals and alloys capable of withstanding the extreme heat generated by ultrasonic flight.

Pettigrew pointed out that before any metal can be considered for use in engine components, it must lend itself to fabrication. He said tungsten and molybdenum are especially suited for the environmental conditions encountered in ultrasonic flight.

An important trend cited by Pettigrew is the increasing demands of the military, industry and commerce for more complex, yet compact, electronic equipment. The importance of transistors, diodes and other miniatures semiconductors was stressed by Pettigrew.

Diamonite moves

Diamonite Products Mfg. Co., has moved its general offices from Canton to Shreve, Ohio. All phases of the firm's operations will be located in Shreve.

New welding symbols issued by AWS

The American Welding Society has issued a new standard for welding symbols containing many additions and improvements.

The addition of new processes and the adoption of many new types of welds have doubled the number of symbols needed.

Two sizes of charts and a booklet containing the symbols are available. The wall chart costs $1.50, the desk chart $0.50 and the booklet $3. All may be obtained from Dept. T., American Welding Society, 33 W. 39th St., New York 18, N. Y.

Marks Oxygen purchases welding supply company

Marks Oxygen Co., Inc., Augusta, Ga., has purchased the capital stock of Alabama Welding Supply Co., Inc., Gadsden, Ala.

The Alabama firm, with retail stores in Gadsden and Huntsville, will be operated as a wholly owned subsidiary of Marks Oxygen. D. M. Yother, president and general manager of the supply company, will continue in this capacity.

Chicago engineering firm moves to new offices

Robert W. Hoffman Co., Inc., abrasive and welding engineers, has moved to new quarters at 5250 W. Kinzie, Chicago. The firm's former address was 32 S. Clinton St.

NEWS

Cornell sweeps top honors in Lincoln competition

For the first time in the 11-year history of the James F. Lincoln Arc Welding Foundation mechanical and structural welded design competition students from one engineering school have swept the top three awards.

Five engineering undergraduates at Cornell University, Ithaca, N. Y., combined their efforts to cop the top awards. First place and $1,250 went to Richard Jarvis, Baltimore, for his design of a triangular truss foot bridge. The $1,000 second award went to John Jenner, LeRoy, N. Y., and E. R. McClean, Philadelphia, for the mechanical design of an automatic welding machine. Gordon Kraus, Freehold, N. J., and Robert Spicher, Indiana, Pa., designed a display arboretum to win third place and $500.

Cornell received $1,750 in scholarship funds to be administered by the Mechanical and Civil Engineering Departments.

Forty-three other awards were given to undergraduates who developed mechanical and structural designs using a significant amount of arc-welding.

Rules for the current competition are available from the Foundation, Box 3035, Cleveland 17, O.

U. S. STEEL's Airsteel X-200 has been sandwich rolled in sheets 140 in. wide. Four plates were sandwiched and rolled into sheets 0.095-in. thick in first rolling of 140-in. sheets. Sheet is designed to meet missile needs for high-tensile steels. John C. Barrett and John H. Garrett, (left and right) from Assistant Secretary of Defense office, examine new wide sheets with Frank Romeo, Chief Development Engineer at USS's Homestead plant. (See "A new missile steel . . ." *WE*, Oct. p. 66, and "Welded steel sandwiches . . ." April, p. 41.)

TOP, aluminum roof lays flat on concrete floor of structure, held air-tight by line of sand, as fans begin forcing air into building. At left, five hours later, building is fully inflated. Workmen on top of end wall seal structure. Conveyor at right will bring grain from old structure to new one, forcing it through opening in roof.

335,000 welds used in air-supported building

An air-supported building required 335,000 welds to shape its roof from 155 separate aluminized-steel sheets.

The building is an experimental grain storage unit with a 1,800,000 bushel capacity built in Fort Worth, Tex., by Cargill Inc., Minneapolis. It is 158 ft wide, 38 ft high, 550 ft long, and has an aluminized-sheeting roof weighing more than 50 tons.

Fabrication of the roof was done on location by a specially developed welding technique producing air-tight seams. *WE* sought further welding details but they are not yet available from Cargill, or the general contractors and engineers, Lee-Emmert, Dallas.

After the roof was welded one side was anchored to an edge of the concrete floor, the other side being left free. The building was then inflated using 40,000-cu-ft-per-minute fans forcing air through floor ducts. As pressure increased, the roof bowed upward at the center, the free edge, held air-tight by a sand weight, was pulled inward until it reached the edge of the concrete floor. Inflation took five hours.

The roof was sealed to the concrete edge and bolted to the end walls, steel semicircles 40 ft high.

Entrance is through air-locks at one end of the building. Grain will enter through the roof along an overhead conveyor from the headhouse of an old elevator near the experimental model.

A. R. O. of France gets "Export Oscar"

An "Export Oscar" in recognition of its efforts in behalf of the French economy was recently awarded A. R. O. Paris by the French government. More than any other European country, France needs more export trade, and the manufacturers of resistance spot welders has 35% of its production sent out of the country.

The "Oscar" was presented in an impressive ceremony to Albert Roland, president of A. R. O. by the then French minister of finance, Antoine Pinay.

Helping to achieve this award were the Paris firm's many distributors throughout the world, for A. R. O. is a truly international organization. More than just a little credit is due its United States distributor, Aro Spot Welder Div. of Guthery Machine Tool Corp., Long Island City, N. Y. Max Osborn is sales manager of the division.

Ultrasonic manufacturers hold annual meeting

The recent meeting of the Ultrasonic Manufacturers Association in Cleveland featured committee and officer's reports, a general discussion of future projects and election of four men to the board of directors.

Elected were Norman G. Branson, Branson Ultrasonic Corp., Stamford, Conn.; Harvey B. Foulkes, Cavitron Equipment Corp., L. I. City, N. Y.; Stanley E. Jacke, Detrex Chemical Industries Inc., Detroit, and Jack T. Welch, Sheffield Corp., Dayton, O.

Three members are serving the second year of their two-year terms. They are Samuel Bagno, Walter Kidde & Co., Inc., Newark; W. C. Potthoff, Aeroprojects Inc., West Chester, Pa., and Robert L. Rod, Acoustica Association Inc., Mineola, L. I., N. Y.

Following the meeting the board of directors met and elected the following officers for the coming year: Welch, president for a second term; Branson, vice president; Rod, secretary for a second term, and Jacke, treasurer.

Welding on program of maintenance conference

Welding, added to the Plant Maintenance and Engineering Conference Program this year, will again have a session devoted to it during the 1959 conference to be held in Cleveland's Public Auditorium, Jan. 26-28. "Arc welding in maintenance" will be covered in an evening session, Jan. 26.

DON Wyatt (right), Mobile Welding Supply Co., receives distributor-of-year plaque from G. E. Sellstrom, president of Sellstrom Mfg. Co. Mrs. Wyatt watches.

Mobile Welding wins Sellstrom contest

Mobile Welding Supply Co., Mobile, Ala., won the Sellstrom Mfg. Co. two-month sales contest. Don Wyatt, representing the Mobile firm, ac-

(Continued on page 93)

For Three Hose Cutting Torches . . . SEPARATE REGULATION

THE NEW TRIPLEX OXYGEN REGULATOR for three-hose flame cutting torches.

Here is a brand new regulator combining into a single unitary body one high pressure stage and two individually adjustable low pressure stages; one low pressure stage to control the preheating flame oxygen and the other one for the high pressure stream of cutting oxygen. The regulator is provided with two outlets, three self-reseating relief valves to protect each individual stage and one inlet. Three 2½" diameter gauges indicate respectively, the low pressure oxygen stream, the high pressure oxygen stream and, the center gauge, the cylinder or cylinder bank pressure. The regulator body and caps are machined of dense brass bar stock, and all internal working parts are interchangeable with all other standard regulators of comparable diameters made by our company. This new Model 5-121, National Triplex Safety Regulator will be of interest to all companies operating three-hose machine cutting torches — write for catalog FORM #16.

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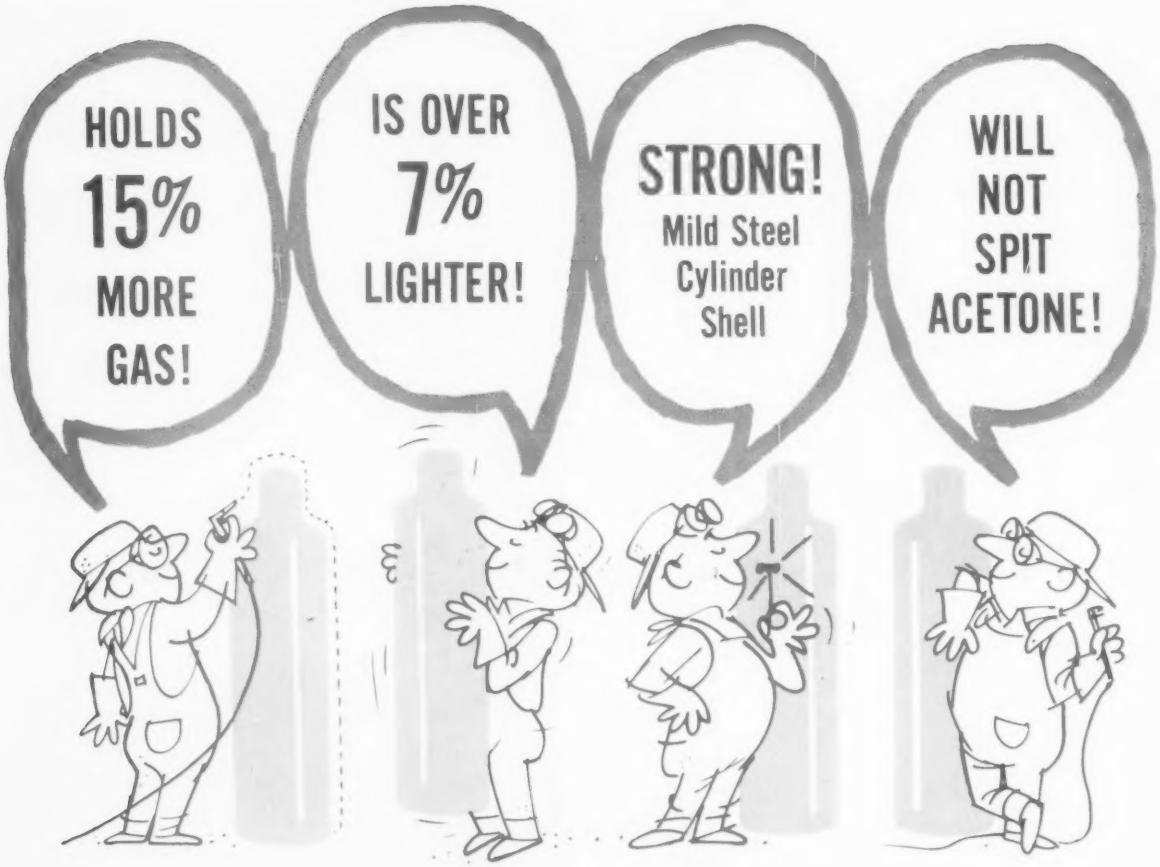

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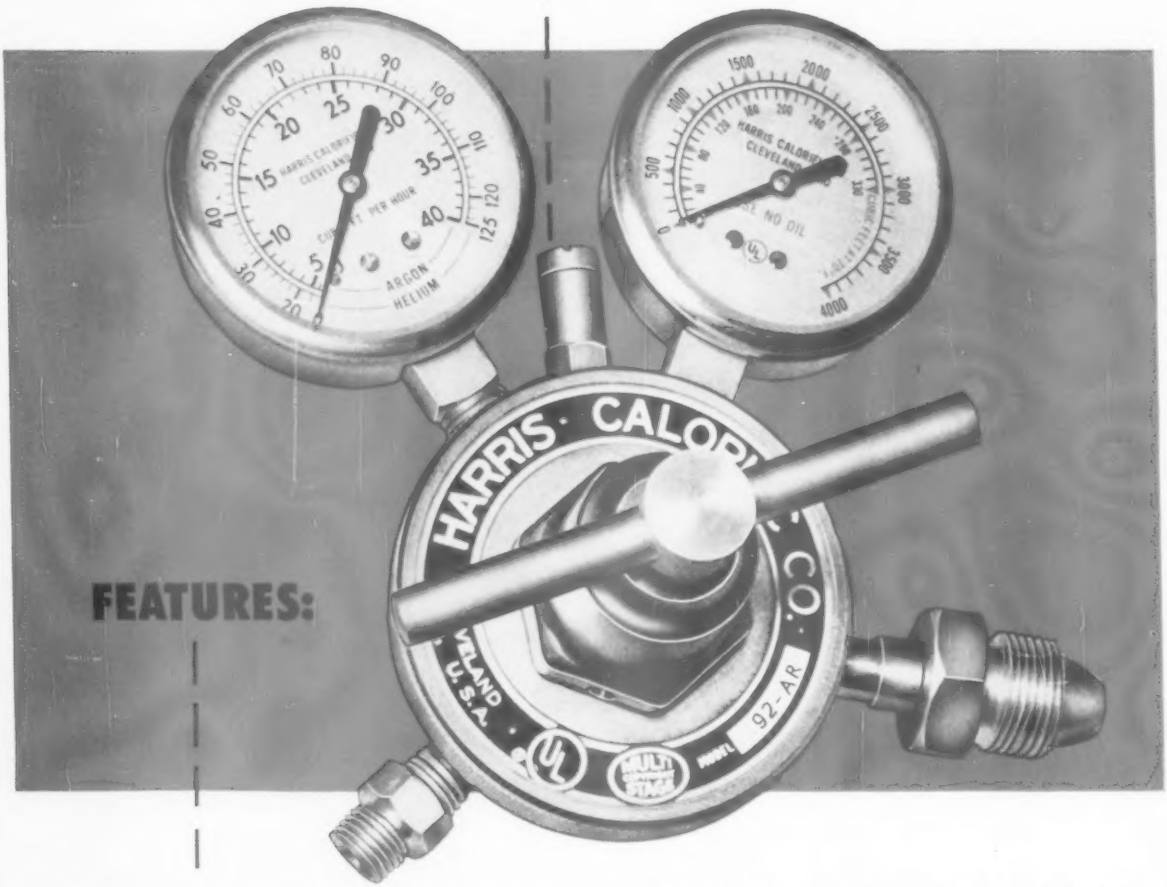

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1. Four times as accurate (within 3%) as most flow-meter type metering regulators.
2. Easily read gauge dial designed to show actual flow in cubic feet per hour consumed.
3. May be attached to the cylinder in any position and accuracy of flow is not affected.
4. Constant flow, as originally set, is maintained as the content of the cylinder decreases.
5. No gaskets to loosen, causing loss of gas and erroneous reading of flows.
6. Price: $43.00.

These features result in greater profit, (more production per cylinder) because accuracy and uniformity of flow permit a lower flow setting.

HARRIS

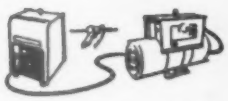
HARRIS CALORIFIC CO.

5501 CASS AVE. • CLEVELAND 2, OHIO

DECEMBER
1958

Your *WeldWorld* at press time

Last minute news of interest to those engaged in joining and severing materials.



. . Next year will see resumption of AWS national fall meeting, putting us back on two-a-year schedule. Fall affair will be held Sept. 28-Oct. 1 in Detroit.

. . Westinghouse says its new, improved transducer should help increase sales of ultrasonic equipment for welding, cutting, cleaning and grinding by 400% in next five years.

. . Picker X-Ray Corp. has introduced industrial X-ray system for radiographic inspection. Image amplifier uses electronic equipment to enlarge X-ray image and transfer it to TV screen.

. . Filler metal and flux for low-temperature torch soldering of titanium have been developed by Research Div., Curtiss-Wright Corp. Butt joints with tensile strengths higher than 40,000 psi are claimed.

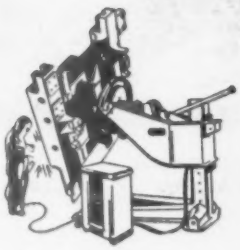
. . Fluor Corp. is building helium production plant in Cimarron County, Okla., under contract let by Interior Dept. Designed to produce 290 million cubic feet of helium annually, plant will have special natural gas supplied by Colorado Interstate Gas Co. from Keyes Field. In short supply for some time, inert helium is now also being used as cooling agent for nuclear reactors and in missiles.

. . Recent Metal Show had 406 exhibitors, and attendance was clocked at 60,238.

. . Business upturn has been indicated by several quarterly reports. Several welding equipment firms said their third quarters were best this year, though still down from similar period of previous year.

. . New horizons in ultrasonic welding are predicted with introduction of 4,000-watt unit by Aeroprojects Inc. New Sonoweld welder will make possible joining of heavier materials. Details next month.

. . Another space age development: plasma gun capable of vaporizing any known element. Temperature generated: 30,000 F. Applications: metal spraying, cutting, heating. Argon, helium and pure nitrogen are used as source of plasma (any ionized gas that no longer behaves like a gas when raised to high temperature). Watch WE for full story.



. . Chemical adhesive developed by Eastman Chemical Products, Inc., subsidiary of Eastman Kodak Co. is said to weld broken bones and bind metals permanently. Only extreme heat can break bond. Cost at present: about $75 a pound.

. . Proposed merger between Sylvania Electric Products, Inc., and General Telephone Corp. would leave Sylvania a division of "General Telephone & Electronics Corp."

Now... here's something

really **NEW!**

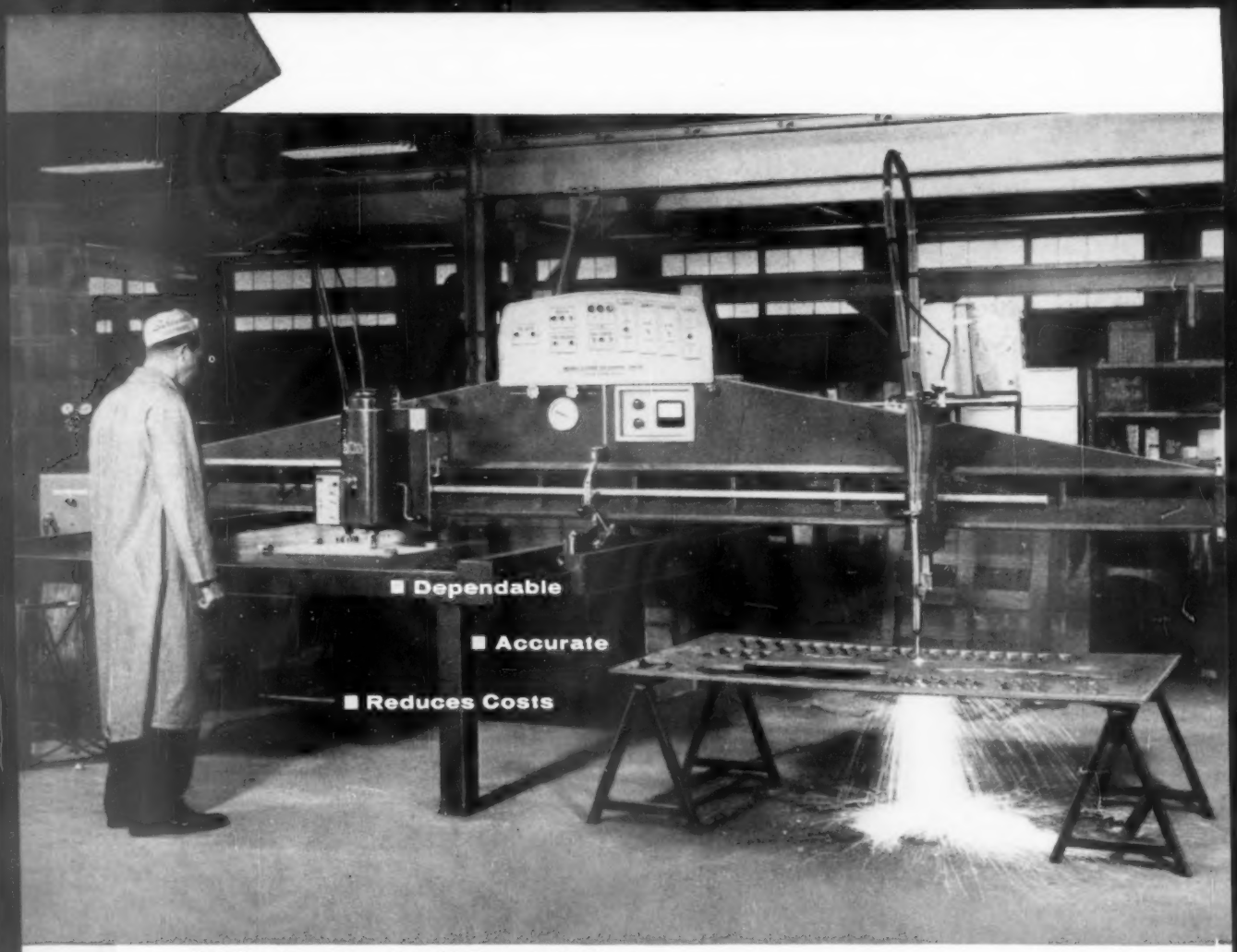
First shown in U.S.
at the 1958 American
Welding Society Show by NCG...
the completely new

NCG®

ELECTRONIC LINE TRACER

Developed for attachment to NCG shape cutting machines, the new NCG Electronic Line Tracer controls the tracing head so it will automatically follow, with extreme accuracy, a pencil or ink line drawing of the part to be cut. Now, the tedious work of manual tracing is eliminated. In addition, the NCG Electronic Line Tracer eliminates the need for costly templets, and reduces the cost of pattern preparation at least 75% compared to other electronic systems which require more complex silhouette type patterns.

NCG Electronic Line Tracer in operation accurately following a pencil drawing.



NCG Type R cutting machine with Electronic Line Tracer

Principal advantages of the NCG® electronic tracing system are:

1 The NCG Electronic Line Tracer will faithfully follow a pencil or ink drawing at speeds up to 25" per minute and execute turns on a minimum radius of 3/32 of an inch. The optical system follows the exact center of any pencil or ink line on white paper. This line may be any width up to 0.040".

2 The NCG Electronic Line Tracer will cross lines . . . it will continue to follow the original line it is tracing even if that line crosses another providing the angle between such lines is not less than 45°. Now, drafting techniques can be developed which will cause the cutting torches to move without interruption from one cut shape to another.

3 The NCG Electronic Line Tracer is not sensitive to or affected by ambient light . . . shape cutting may be accomplished anywhere regardless of lighting conditions.

4 It operates with ease . . . just a touch of the switch steers the tracing head to the drawing. The line tracer scanning system then automatically follows the line drawing. When the tracing unit reaches the end of the drawing it automatically stops. This eliminates plate spoilage.

Available now, bulletin N-142 describing in detail this sensationally new NCG Electronic Line Tracer. Call your nearest NCG office or write today.

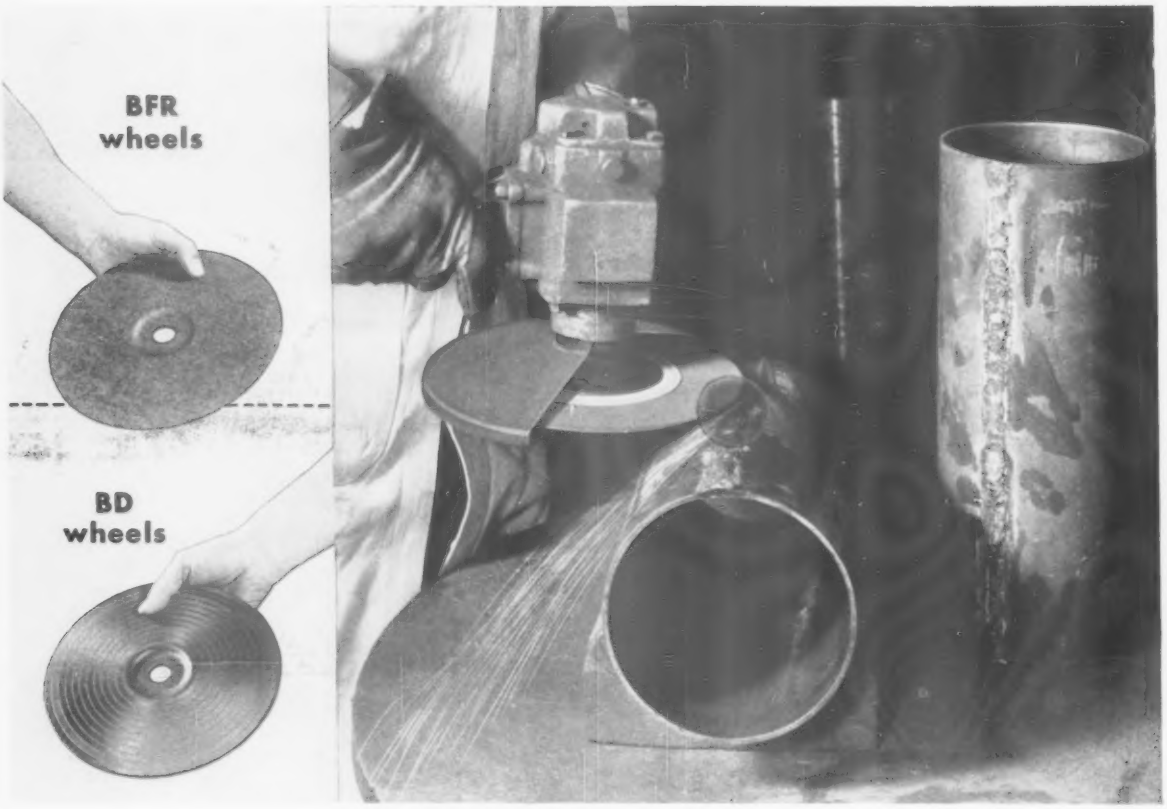
NATIONAL CYLINDER GAS

Division of Chemetron Corporation

840 N. MICHIGAN AVE., CHICAGO 11, ILL.

CHEMETRON

© 1958, CHEMETRON CORPORATION



Reinforced to cut grinding costs . . . all around your shop

Norton BFR and BD wheels are extra strong . . . add extra speed and economy to light and heavy jobs

The BFR Wheel is the one you see in action above. A free-cutting, semi-flexible, hub-type wheel, the BFR is made of cotton fabric, reinforced with strong nylon webbing. It adds the money-saving "Touch of Gold" to lighter weld grinding — as well as to blending contours and corners, removing rust and scale, scarfing and beveling before welding, reaching hard-to-get-at places.

The BD Wheel gives best performance on your toughest jobs. Made of glass cloth plus nylon, this rigid hub-type wheel is ideal for grinding medium to heavy welds, including stainless steel — and for smoothing flame-cut edges, removing fins from castings, slotting, notching and cutting-off. Available in three grades of hardness.

Just two of the complete line of Norton reinforced wheels, the BFR and BD handle an almost endless list of weld shop grinding jobs. To get complete details on their built-in strength, versatility and resistance to breakage, ask your Norton Distributor for the catalog on Norton reinforced wheels, Form 1748. Or write to NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world.

NORTON
ABRASIVES

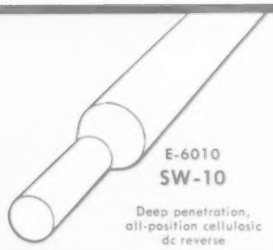
Making better products . . . to make your products better

NORTON PRODUCTS Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals — **BEHR-MANNING DIVISION** Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

A. O. SMITH OFFERS

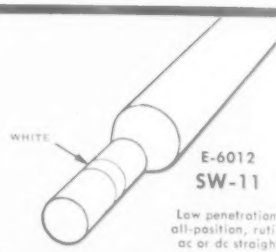
Ch

MILD STEEL



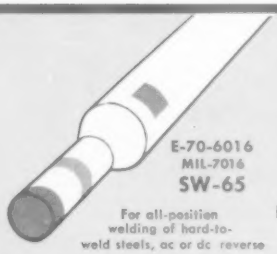
E-6010
SW-10
Deep penetration, all-position cellulosic dc reverse

E-6011
SW-14
Deep penetration, all-position cellulosic ac-dc reverse

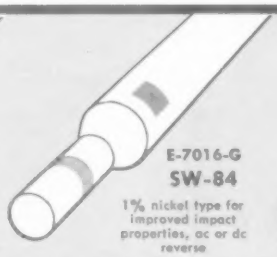


E-6012
SW-11
Low penetration, all-position, rutile ac or dc straight

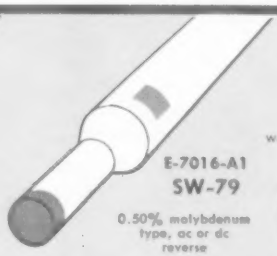
LOW HYDROGEN



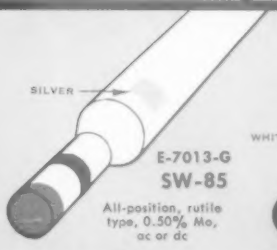
E-70-6016
MIL-7016
SW-65
For all-position welding of hard-to-weld steels, ac or dc reverse



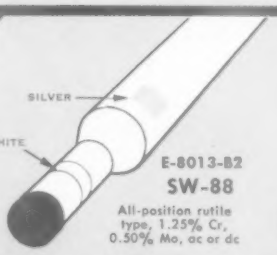
E-7016-G
SW-84
1% nickel type for improved impact properties, ac or dc reverse



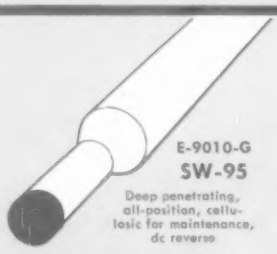
E-7016-A1
SW-79
0.50% molybdenum type, ac or dc reverse



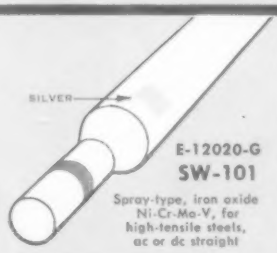
E-7013-G
SW-85
All-position, rutile type, 0.50% Mo, ac or dc



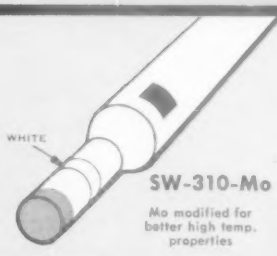
E-8013-B2
SW-88
All-position rutile type, 1.25% Cr, 0.50% Mo, ac or dc



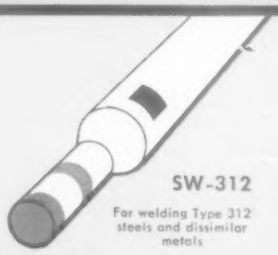
E-9010-G
SW-95
Deep penetrating, all-position, cellulosic for maintenance, dc reverse



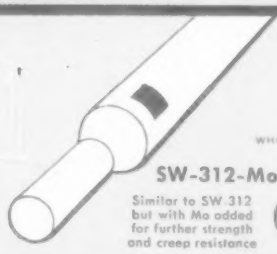
E-12020-G
SW-101
Spray-type, iron oxide Ni-Cr-Mo-V, for high-tensile steels, ac or dc straight



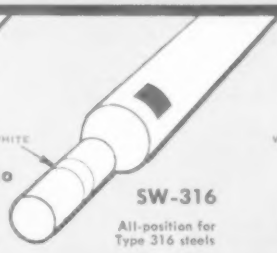
SW-310-Mo
Mo modified for better high temp. properties



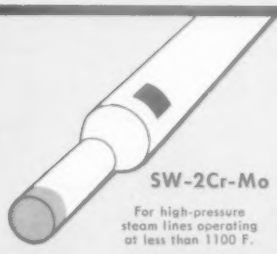
SW-312
For welding Type 312 steels and dissimilar metals



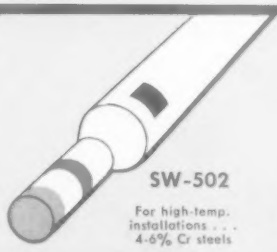
SW-312-Mo
Similar to SW-312 but with Mo added for further strength and creep resistance



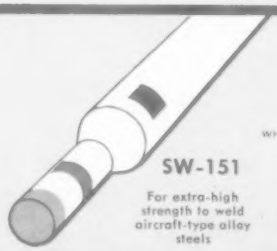
SW-316
All-position for Type 316 steels



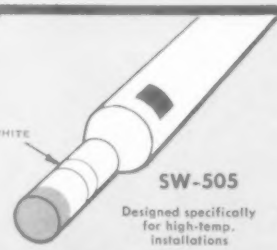
SW-2Cr-Mo
For high-pressure steam lines operating at less than 1100 F.



SW-502
For high-temp. installations . . . 4-6% Cr steels

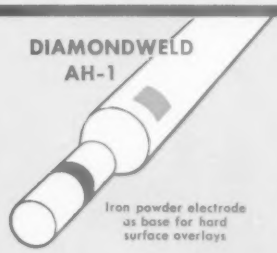


SW-151
For extra-high strength to weld aircraft-type alloy steels



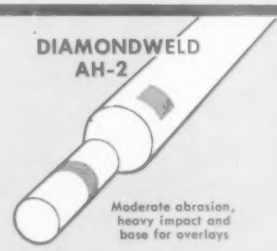
SW-505
Designed specifically for high-temp. installations

DIAMONDWELD AH-1



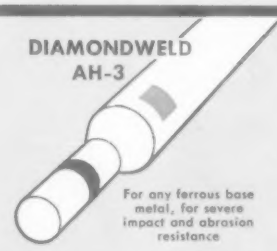
Iron powder electrode as base for hard surface overlays

DIAMONDWELD AH-2



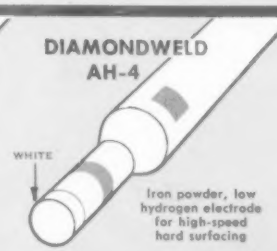
Moderate abrasion, heavy impact and base for overlays

DIAMONDWELD AH-3



For any ferrous base metal, for severe impact and abrasion resistance

DIAMONDWELD AH-4

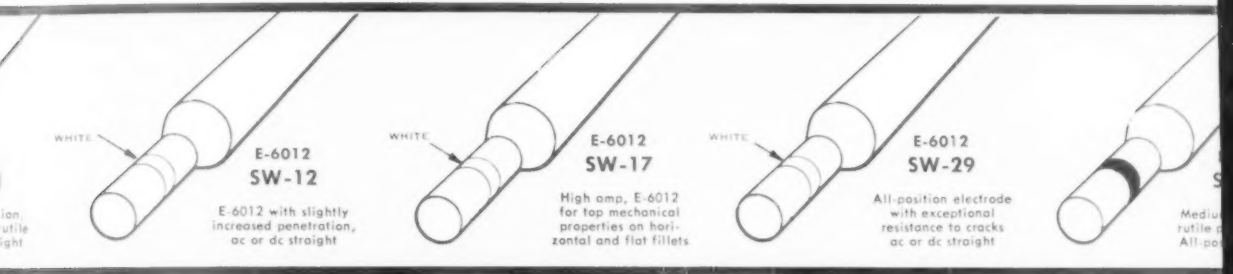


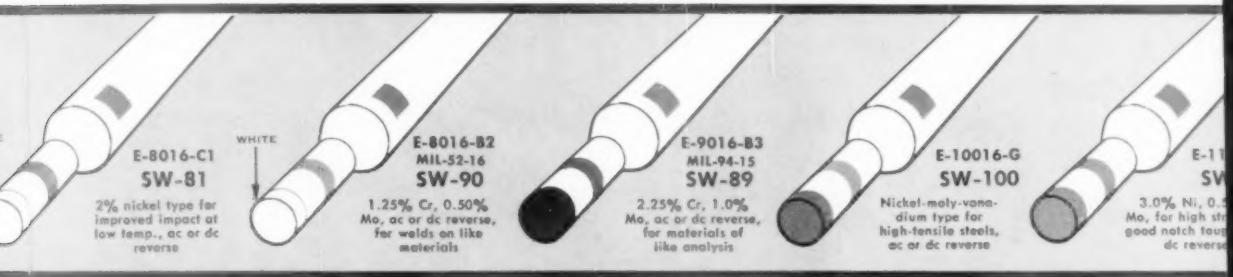
Iron powder, low hydrogen electrode for high-speed hard surfacing

DI

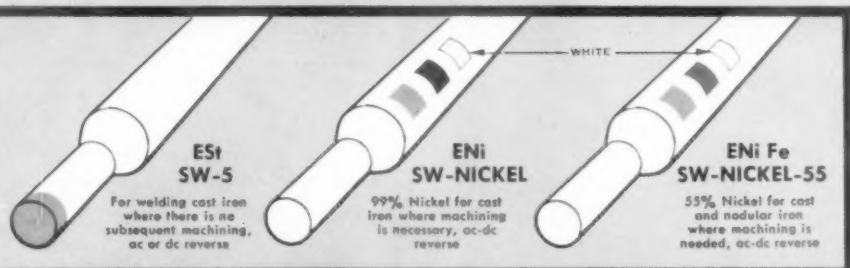
RS THE INDUSTRY'S MO

Choose from 87 basic types co



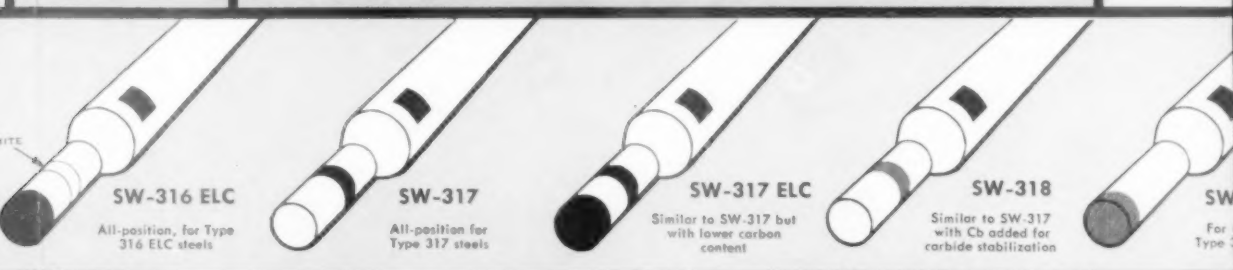


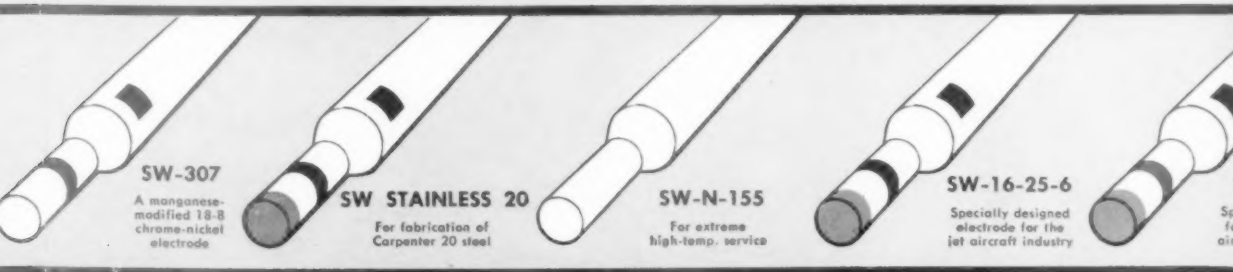
CAST IRON

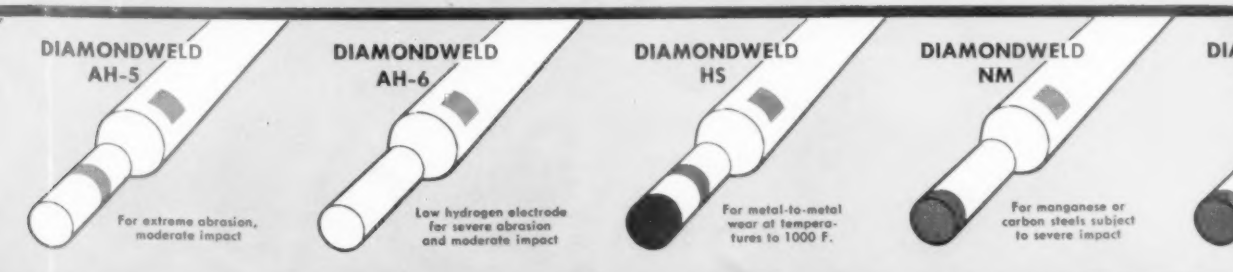

WHITE
ESt
SW-5
For welding cast iron where there is no subsequent machining, ac or dc reverse
ENi
SW-NICKEL
99% Nickel for cast iron where machining is necessary, ac-dc reverse
ENi Fe
SW-NICKEL-55
55% Nickel for cast and nodular iron where machining is needed, ac-dc reverse

STAINL

*NOTE—grou
lime and dc
color coding
more details,

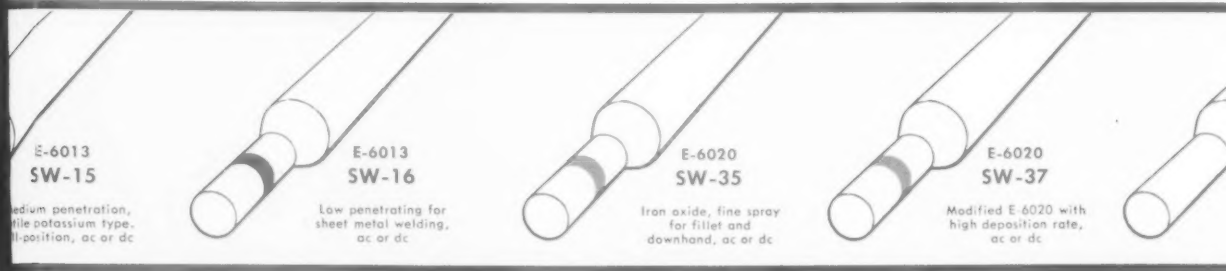

SW-316 ELC
All-position, for Type 316 ELC steels
SW-317
All-position for Type 317 steels
SW-317 ELC
Similar to SW-317 but with lower carbon content
SW-318
Similar to SW-317 with Cb added for carbide stabilization





OST COMPREHENSIVE LI

overing all major classifications

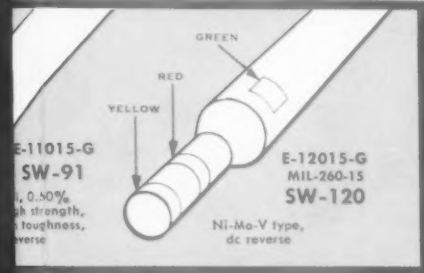


E-6013
SW-15
edium penetration,
tile potassium type.
ll-position, ac or dc

E-6013
SW-16
Low penetrating for sheet metal welding, ac or dc

E-6020
SW-35
Iron oxide, fine spray for fillet and downhand, ac or dc

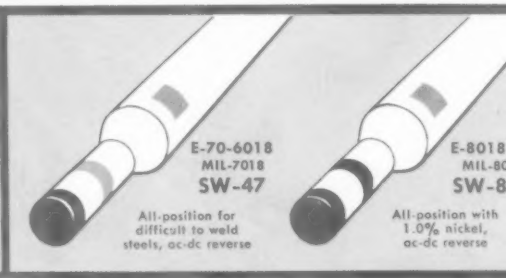
E-6020
SW-37
Modified E-6020 with high deposition rate, ac or dc



E-11015-G
SW-91
, 0.50%
h strength,
toughness,
verse

E-12015-G
MIL-260-15
SW-120
Ni-Mo-V type, dc reverse

LOW HYDROGEN IRON POWDER

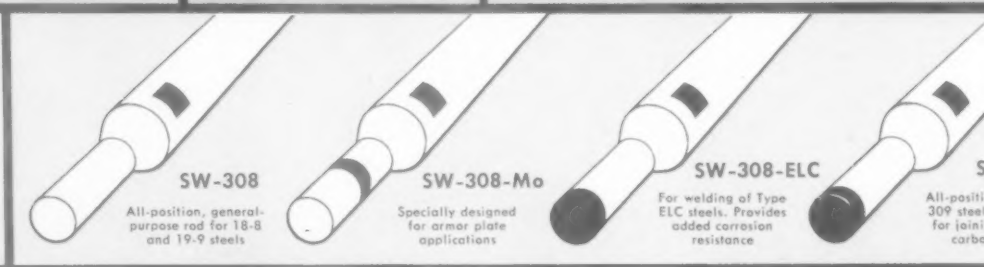


E-70-6018
MIL-7018
SW-47
All-position for difficult to weld steels, ac-dc reverse

E-8018
MIL-80
SW-8
All-position with 1.0% nickel, ac-dc reverse

NLESS STEEL

group color coding for dc
dc titania is black. Group
ng for ac-dc is yellow. For
ails, ask for Cat. MW-196.

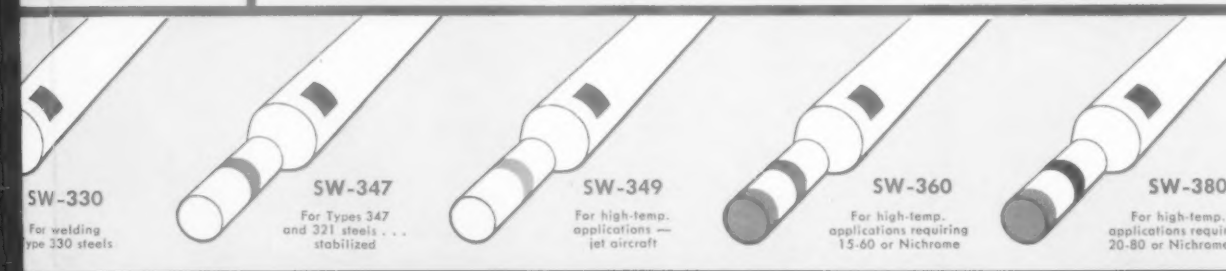


SW-308
All-position, general-purpose rod for 18-8 and 19-9 steels

SW-308-Mo
Specially designed for armor plate applications

SW-308-ELC
For welding of Type ELC steels. Provides added corrosion resistance

All-positi
309 steel
for joini
carbo



SW-330
For welding
ype 330 steels

SW-347
For Types 347 and 321 steels . . . stabilized

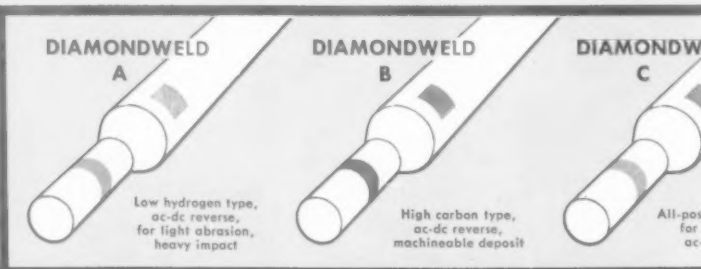
SW-349
For high-temp. applications — jet aircraft

SW-360
For high-temp. applications requiring 15-60 or Nichrome

SW-380
For high-temp.
applications requi
20-80 or Nichrom

SW-L605
Specially designed for high-temp. jet aircraft applications

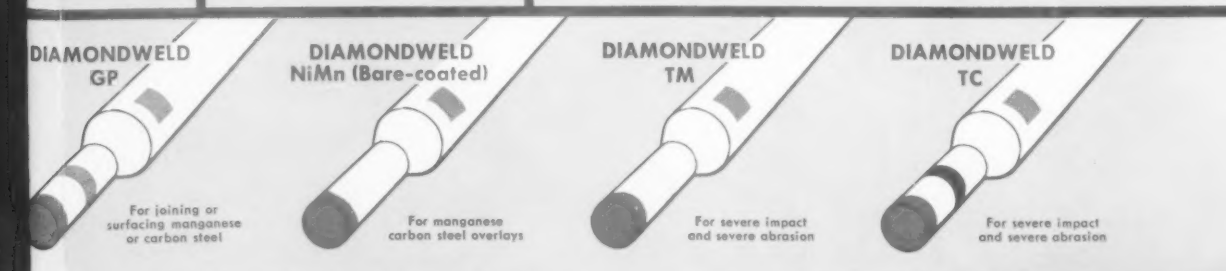
HARD SURFACING ELECTRODES



DIAMONDWELD A
Low hydrogen type, ac-dc reverse, for light abrasion, heavy impact

DIAMONDWELD B
High carbon type, ac-dc reverse, machineable deposit

DIAMONDW C
All-pos
for
ac



DIAMONDWELD GP
For joining or surfacing manganese or carbon steel

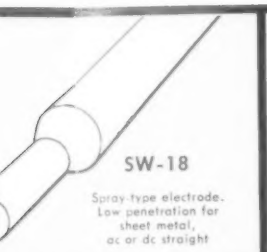
DIAMONDWELD NiMn (Bare-coated)
For manganese carbon steel overlays

DIAMONDWELD TM
For severe impact and severe abrasion

DIAMONDWELD TC
For severe impact and severe abrasion

LINE OF ELECTRODES

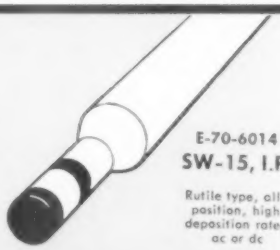
ns



SW-18

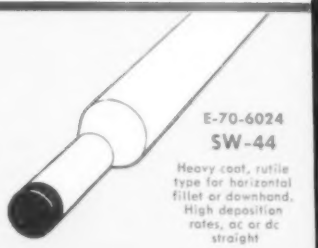
Spray-type electrode. Low-penetration for sheet metal, ac or dc straight

IRON POWDER



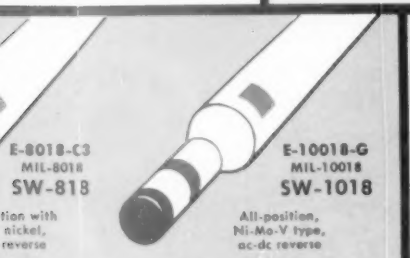
E-70-6014
SW-15, I.P.

Rutile type, all-position, high deposition rate, ac or dc



E-70-6024
SW-44

Heavy coat, rutile type for horizontal fillet or downhand. High deposition rates, ac or dc straight



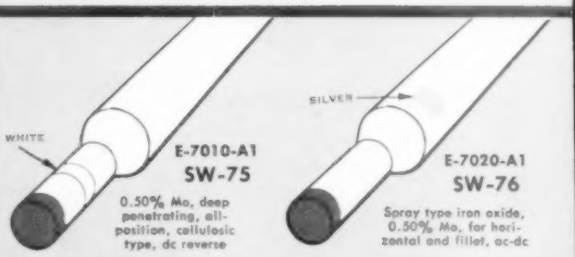
E-8018-C3
MIL-8018
SW-818

tion with nickel, reverse

E-10018-G
MIL-10018
SW-1018

All-position, Ni-Mo-V type, ac-dc reverse

LOW ALLOY HIGH TENSILE

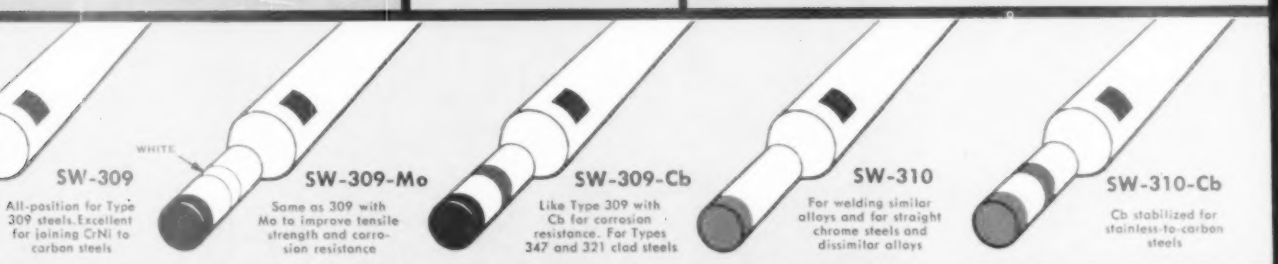


E-7010-A1
SW-75

0.50% Mo, deep penetrating, all-position, cellulosic type, dc reverse

E-7020-A1
SW-76

Spray type iron oxide, 0.50% Mo, for horizontal and fillet, ac-dc



SW-309

All-position for Type 309 steels. Excellent for joining CrNi to carbon steels

SW-309-Mo

Same as 309 with Mo to improve tensile strength and corrosion resistance

SW-309-Cb

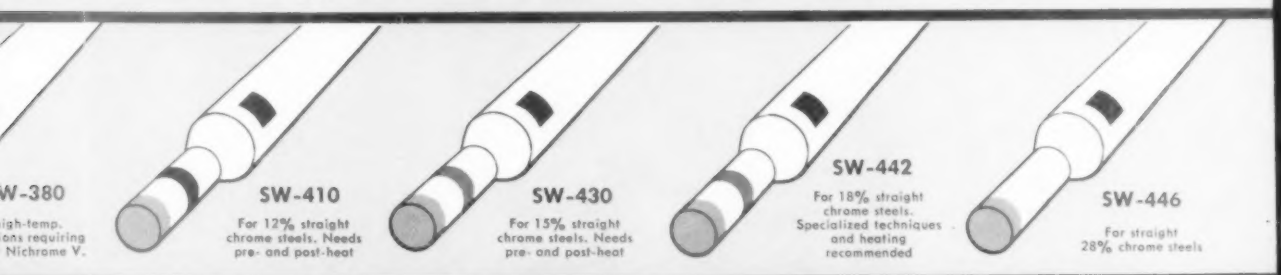
Like Type 309 with Cb for corrosion resistance. For Types 347 and 321 clad steels

SW-310

For welding similar alloys and for straight chrome steels and dissimilar alloys

SW-310-Cb

Cb stabilized for stainless-to-carbon steels



W-380

igh-temp. ons requiring Nichrome V.

SW-410

For 12% straight chrome steels. Needs pre- and post-heat

SW-430

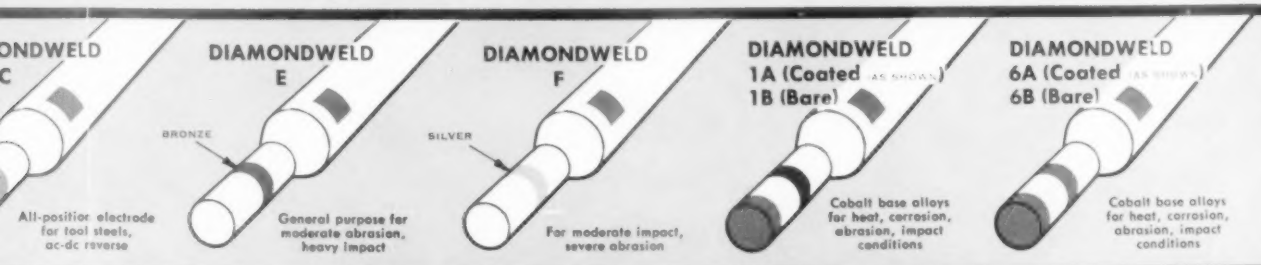
For 15% straight chrome steels. Needs pre- and post-heat

SW-442

For 18% straight chrome steels. Specialized techniques and heating recommended

SW-446

For straight 28% chrome steels



ONDWELD C

All-position electrode for tool steels, ac-dc reverse

DIAMONDWELD E

General purpose for moderate abrasion, heavy impact

DIAMONDWELD F

For moderate impact, severe abrasion

DIAMONDWELD 1A (Coated) 1B (Bare)

Cobalt base alloys for heat, corrosion, abrasion, impact conditions

DIAMONDWELD 6A (Coated) 6B (Bare)

Cobalt base alloys for heat, corrosion, abrasion, impact conditions

Plus automatic wires to meet every need —

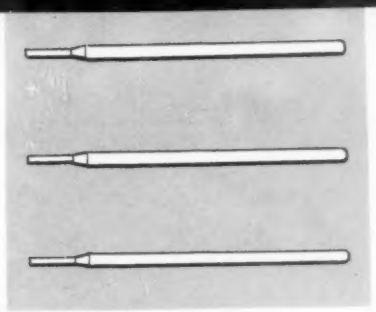
A. O. Smith also offers a line of wires for automatic and semi-automatic welding for all types of steels. They include:

MILD STEEL — CO-85, CO-86. Designed particularly for carbon-dioxide shielded arc welding processes • **STAINLESS** — 308, 308 ELC, 309, 310, 316, 316 ELC, 330, 347, 321, 2 Cr Mo, 502, 410, 430, 446, 349, 312, Stainless 20 • **HARD FACING** — Gp 600, AH 100, NM 700, AH 500, AH 200, AH 300, AH 420.

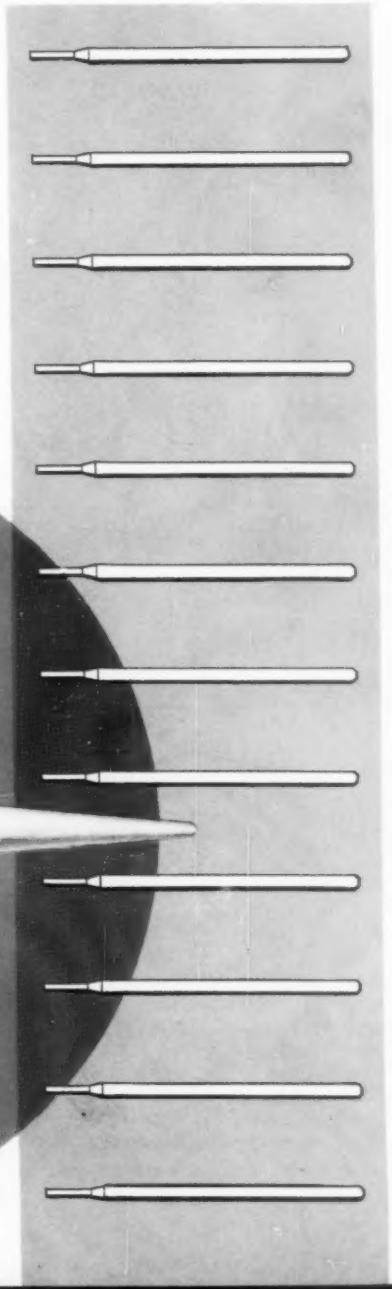
Through research A.O. Smith *. . . a better way*

A.O.Smith
CORPORATION
WELDING PRODUCTS DIVISION
Milwaukee 1, Wisconsin

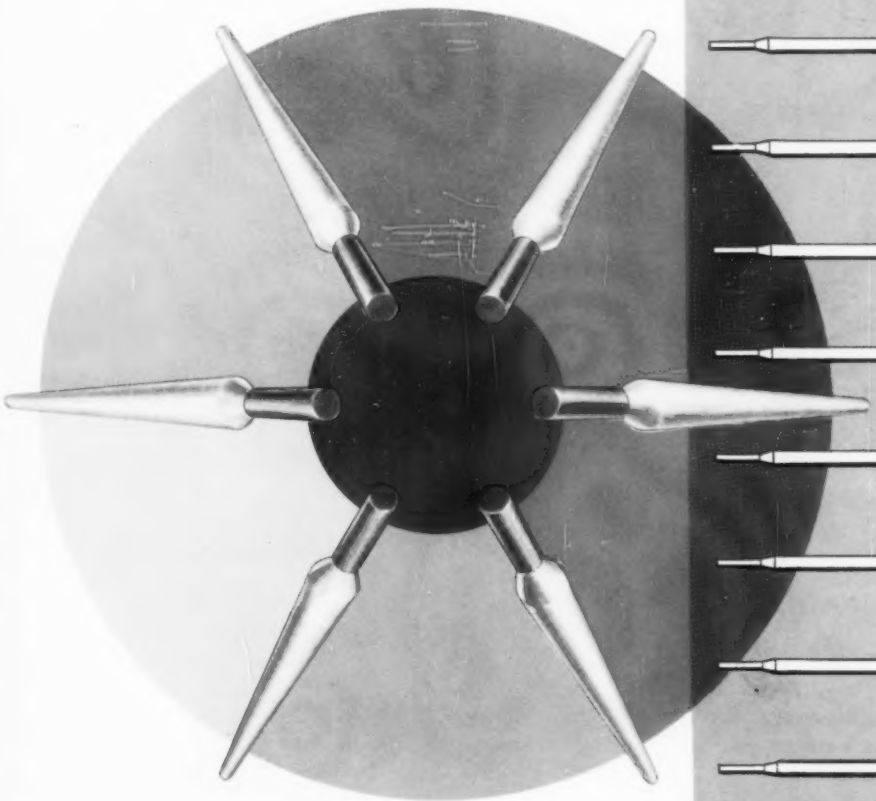
A. O. Smith INTERNATIONAL S. A. Milwaukee 1, Wis., U. S. A.



NOW... *from A. O. Smith*



NEW ELECTRODE CATALOG –KEYED TO NEW A.W.S. SPECIFICATIONS AND NEW NEMA COLOR CODE



HERE'S MORE D

MILD STEEL

6010 MIL-6010 SW-10 dc reverse

All position. High cellulosic coating. Deep penetrating or cutting arc.

PROCEDURE: Horizontal and downhand welding: hold a medium to short arc, tilted 5° to 15° in direction of travel. Weave with a slightly oscillating motion, hesitating at the edges to insure proper fusion. Clean each bead before depositing next. Vertical and overhead welding: for best results hold electrode perpendicular to the work. Weaving of the electrode should be limited to allow only time enough for molten metal to set up.

	As Welded	Stress Relieved
Yield Point psi	59,200	53,800
Tensile Strength psi	71,150	67,600
% Elongation in 2"	29.9	34.5

X-Ray Quality

C	Mn	P	S	Si
.08	.47	.022	.026	.21

Complies with:
U. S. Navy — Spec. MIL-E-15599
A. B. S. — E 6010
U. S. Coast Guard
Lloyds Register of Shipping

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter		1/8"	5/32"	3/16"	7/32"	1/4"
length		14"	14"	14"	18"	18"
amperes	flat	110-130	140-160	170-190	220-250	240-300
	vertical	110-120	130-140	150-170		
	overhead	110-120	135-140	165-175		
volts		25-27	27-29	27-29	28-30	28-32

MILD

E 6011 SW-14 ac--dc re

All-position cellulosic electrode. Produces easily controlled forcef with deep penetration. "Hot strength" characteristics guard against c

PROCEDURE: Hold a medium to short arc tilted 5° to 15° in the dir of travel, with the electrode at an angle of 45° to each plate. Weave slight oscillating motion, hesitating at the edges to insure proper f Clean each bead before depositing next.

	As Welded	Stress Relieved
Yield Point psi	65,500	55,100
Tensile Strength psi	75,500	66,400
% Elongation in 2"	26.5	33.5

X-Ray Quality

C	Mn	P	S	Si
.07	.40	.020	.025	.10

Complies with:
A. B. S. — E 6011
Lloyds Register of Shipping
U. S. Coast Guard

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter		3/32"	1/8"	5/32"	3/16"	7/32"
length		12"	14"	14"	14"	18"
amperes	flat	70-80	100-130	130-160	155-190	175-220
	vertical	60-70	100-120	130-150	155-180	
	overhead	60-70	100-120	130-150	160-180	
volts		22-24	25-27	27-29	29-31	30-32

MILD STEEL

E 6020 SW-37 ac—dc

An exceptionally high-speed iron oxide electrode for downhand and horizontal fillet welding. Produces less concave fillets and smooth finish pass welds at high speeds with high ductility and notch toughness.

PROCEDURE: Open arc with short arc for downhand welds, and open arc or drag technique for fillet welding. Tilt electrode in direction of travel to maintain slag-free puddle.

	As Welded	Stress Relieved
Yield Point psi	52,000	62,000
Tensile Strength psi	65,000	73,000
% Elongation in 2"	29.0	31.0

X-Ray Quality

C	Mn	P	S	Si
.09	.42	.015	.025	.25

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

	7/32"	1/4"	5/16"
diameter			
length	18"	18"	18"
amperes	280-310	300-350	370-410
volts	32-35	33-36	35-38

MILD

Not Classified SW-18 ac--dc st

A mineral type electrode for high-speed welding of sheet meta electrode for welding vertically down. Also excellent for lap weld izontal fillet welds, skip welds and tacking for set-up, because of lent restriking characteristics.

PROCEDURE: For flat or overhead welds—tilt electrode 5° to 15° in tion of travel. Hold very short arc, preferably using a drag wel nique. For welding vertically down use drag technique, tilting el 15° to 30° in direction of travel.

	As Welded
Yield Point psi	57,000
Tensile Strength psi	66,500
% Elongation in 2"	23.5

C	Mn	P	S
.10	.42	.023	.022

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter		1/8"	5/32"	3/16"	
length		14"	14"	14"	
amperes	flat	110-140	130-160	200-240	260
	vertical down	120-150	140-180	210-250	
	overhead	110-140	120-150	180-220	
volts		22-24	23-25	24-26	25

LOW HYDROGEN

E 9016 B3 MIL 94-15 SW-89 ac—dc reverse

A low hydrogen type electrode designed for welding 2.25% Cr-1.0% Mo steels. Outstanding for welding of high-pressure, high-temperature piping found in power houses.

PROCEDURE: Pre- and post-heat treatment to job specification. Tilt electrode 5° to 15° in direction of travel. Hold short arc. Use weaving or beading technique. Important to clean crater before restriking. Restrike in center of crater and move back toward previous bead. Then reverse direction.

Yield Point psi	81,550
Tensile Strength psi	95,800
% Elongation in 2"	22.0

X-Ray Quality

C	Mn	P	S	Si	Cr	Mo
.05	.65	.020	.029	.48	2.21	1.18

Complies with:
A. B. S. — Class E 9016 B3
U. S. Coast Guard — Class E 9016 B3
U. S. Navy — MIL-E-16589
MIL-94-15

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter		1/8"	5/32"	3/16"
length		14"	14"	14"
amperes	flat	120-170	160-200	195-260
	vertical	90-120	110-140	140-170
	overhead	100-130	130-160	170-200
volts		23-24	24-25	25-26

LOW HYD

E 10016 G SW-100 ac--dc

The low hydrogen type coating is balanced to provide extreme handling and excellent physical properties required for armor plat high ductility and unusually good impact values.

PROCEDURE: Tilt electrode 5° to 15° in direction of travel. Hold sh Use weaving or beading technique. Important to clean crater be striking. Restrike in center of crater and move back toward p bead. Then reverse direction.

	As Welded
Yield Point psi	94,500
Tensile Strength psi	105,000
% Elongation in 2"	22.5

X-Ray Quality

C	Mn	P	Si	Mo	V
.07	1.00	.020	.23	.42	.10

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter		1/8"	5/32"	
length		14"	14"	
amperes	flat	120-170	160-200	19
	vertical	90-120	110-140	14
	overhead	100-130	130-160	17
volts		23-24	24-25	2

LOW ALLOY — HIGH TENSILE

E 7013 G SW-85 ac—dc

An all-position, rutile electrode with excellent handling characteristics for welding high tensile steels.

This electrode has been used with great success on high tensile steels and on high pressure, high temperature chrome-moly piping.

PROCEDURE: Pre- and post-heat treatment in accordance with job specifications. For flat welds—tilt 5° to 15° in direction of travel. Hold medium length arc. For horizonal fillets—tilt 5° to 15° in direction of travel at angle bisecting the vertical and base plate. Hold medium length arc.

	As Welded
Yield Point psi	73,000
Tensile Strength psi	83,000
% Elongation in 2"	22.0

X-Ray Quality

C	Mn	Si	Mo
.09	.43	.45	.55

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter		1/8"	5/32"	3/16"
length		14"	14"	14"
amperes	flat	120-130	150-165	190-220
	vertical	110-115	135-160	170-185
	overhead	110-120	145-165	170-185
volts		23-25	25-27	26-28

LOW ALLOY — HIGH

E 8013 B2 SW-88

An all-position, rutile electrode with excellent handling charac for welding high tensile steels.

This electrode has been used with great success on high tensil and on high pressure, high temperature chrome-moly piping.

PROCEDURE: Pre- and post-heat treatment in accordance with job cations. For flat welds—tilt 5° to 15° in direction of travel. Hold length arc. For horizonal fillets—tilt 5° to 15° in direction of angle bisecting the vertical and base plate. Hold medium length

	As Welded
Yield Point psi	102,000
Tensile Strength psi	113,850
% Elongation in 2"	17.0

X-Ray Quality

C	Mn	Si	Cr
.09	.43	.50	1.45

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter		1/8"	5/32"
length		14"	14"
amperes	flat	120-130	150-165
	vertical	110-115	135-160
	overhead	110-120	145-165
volts		23-25	25-27

DETAILED INFORMA

MILD STEEL

c—dc reverse
d forceful arc
against cracks.
the direction
e. Weave with
proper fusion.

	1/4"
	18"
20	225-260
32	31-33

MILD STEEL

c—dc straight
et metal. Best
ap welds, hor-
ause of excel-

o 15° in direc-
rag weld tech-
lting electrode

S	Si
.022	.02

	7/32"
	18"
	260-310
	25-27

W HYDROGEN

c—dc reverse
xtreme ease in
mo: plate work.

Hold short arc.
ater before re-
ward previous

Quality

P	S
020	.022

V	Ni
.10	1.70

E:

	3/16"
	14"
	195-260
	140-170
	170-200
	25-26

HIGH TENSILE

ac—dc
characteristics

h tensile steels
iping.
vith job specifi-
l. Hold medium
ion of travel at
length arc.

uality

Cr	Mo
1.45	.62

E:

	3/16"
	14"
	190-220
	170-185
	170-185
	26-28

MILD STEEL

E 6012 SW-11 ac—dc straight

High rutile electrode. Good on poor fit-up. For use in welding jobs calling for a "cold" E-6012 electrode. Outstanding in vertical down applications.

PROCEDURE: Hold a short arc or lightly touch coating to work, holding sufficient current so electrode does not stick, with the electrode tilted 5° to 15° in the direction of travel. For vertical welding, weld from the bottom up for heavy beads and down for small beads.

	As Welded	Stress Relieved
Yield Point psi	65,900	64,100
Tensile Strength psi	76,000	74,800
% Elongation in 2"	18.5	19.0

Complies with:
A. B. S. — E 6012
U. S. Coast Guard

C	Mn	P	S	Si
.07	.30	.022	.025	.20

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter		3/32"	1/8"	5/32"	3/16"	1/4"
length		12"	14"	14"	14"	18"
amperes	flat	70-80	120-140	160-185	200-240	280-330
	vertical	60-75	110-120	140-165	160-185	
	overhead	60-75	110-120	140-160	160-185	
volts		21-23	24-25	25-26	26-27	26-27

IRON POWDER

E 70-6014 SW-15 IP ac—dc

A high-speed medium-heavy coated iron powder all-position electrode with sufficient penetration to assure root fusion and eliminate porosity in fillets. Designed for general-purpose welding where full positioning is not practical. Assures equal leg fillets to eliminate necessity of over-welding. Self-cleaning slag.

PROCEDURE: Open or drag technique may be used. Use medium to short arc on open arc and in both methods vary angle of electrode in direction of travel.

	As Welded	Stress Relieved
Yield Point psi	52,000	62,000
Tensile Strength psi	65,000	73,000
% Elongation in 2"	25.0	31.0

Complies with:
A. B. S. — E 70-6014
U. S. Coast Guard

X-Ray Quality

C	Mn	P	S	Si
.09	.40	.015	.025	.23

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter		3/32"	1/8"	5/32"	3/16"	7/32"	1/4"	5/16"
length		12"	14"	14"	14"	18"	18"	18"
amperes	flat	70-100	120-150	160-200	230-270	290-330	340-400	400-440
	vertical	65-80	100-120	160-180	190-210			
	overhead	70-90	120-130	160-180	210-230			
volts		22-24	22-24	22-26	22-26	24-28	24-28	26-28

LOW HYDROGEN

E 11015 G SW-91 dc reverse

For all-position welding of Carilloy T-1 steel and high-tensile steels such as armor plate and other heat treated steel requiring high notch bar impact values.

PROCEDURE: Tilt electrode 5° to 15° in direction of travel. Hold short arc. Weaving or beading technique. Restrike in center of crater and move back toward previous bead. Then reverse direction.

	As Welded	Stress Relieved*
Yield Point psi	100,000	100,000
Tensile Strength psi	110,000	112,000
% Elongation in 2"	22.0	20.0
Keyhole Charpy ft. lbs. @ —65 F	32.0	26.0
V-Notch Charpy ft. lbs. @ —65 F	23.0	24.0

*Stress relieved at 1150F for one hour, furnace cooled.

X-Ray Quality

C	Mn	Si	Ni	Mo
.05	.94	.29	3.0	.62

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter		1/8"	5/32"	3/16"	7/32"	1/4"
length		14"	14"	14"	18"	18"
amperes	flat	120-170	160-200	195-260	230-310	280-350
	vertical	90-120	110-150			
	overhead	100-130	130-160			
volts		23-24	24-25	25-26	26-27	26-28

LOW ALLOY — HIGH TENSILE

E 9010 G SW-95 dc reverse

For maintenance and repair work particularly where rust, paint and scale are present. Will burn through rust, paint and scale when most other electrodes fail.

PROCEDURE: Horizontal and downhand — hold medium to close arc, with electrode tilted 5° to 15° in direction of travel. Weave with oscillating motion hesitating at edges. Clean each bead. Vertical and overhead welding — hold electrode perpendicular to work. Weaving should be limited to allow only time enough for set up.

	As Welded	Stress Relieved
Yield Point psi	91,500	87,650
Tensile Strength psi	102,500	98,150
% Elongation in 2"	16.0	18.5

X-Ray Quality

C	Mn	P
.12	.65	.02

S	Si	V
.025	.30	15

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter		1/8"	5/32"	3/16"
length		14"	14"	14"
amperes	flat	110-120	140-160	170-180
	vertical	110-120	130-140	140-160
	overhead	110-120	130-140	140-170
volts		25-27	26-28	27-29

E 6012 SW-12

A high rutile electrode — good on poor fit-up electrode useful in applications where the range is employed.

Widely used for pipe booms • ship bulkhead base forms • electrical switch gears • tanks all types • steel houses.

PROCEDURE: Hold a short arc or lightly t sufficient current so electrode does not stick the direction of travel. For vertical weldin

	As Welded	Stress Relieved
Yield Point psi	65,900	64,100
Tensile Strength psi	76,000	74,800
% Elongation in 2"	18.5	19.0

RECOMMENDED AMPERAGE AND

diameter		1/8"	5/32"
length		14"	14"
amperes	flat	120-140	160-185
	vertical	110-120	140-165
	overhead	110-120	140-160
volts		24-25	25-26

E 70-6024 SW-44

A high-speed, heavy-coated, iron powder trode for high deposition rates on horizontal duces an equal-leg 45° fillet to eliminate appearance with self-cleaning slag. Large fil with absolutely no undercut.

PROCEDURE: Drag technique should be used fillets. Tilt electrode 5° to 10° in direction base plate. No weaving necessary.

	As Welded
Yield Point psi	75,000
Tensile Strength psi	87,500
% Elongation in 2"	25.0

C	Mn	P	S	Si
.09	.74	.030	.020	.80

RECOMMENDED AMPERAGE AND

diameter		1/8"	5/32"
length		14"	14"
amperes		150-180	180-220
volts		33-35	34-36

LOW HYDROGEN

E 12015G MIL-260-15

For armor plate and non-heat-treated cast alloy steels. This electrode has a heavy, low produces a weld metal of unusually high condition.

PROCEDURE: Tilt electrode 5° to 15° in direct Use weaving or beading technique. Importa striking. Restrike in center of crater and bead. Then reverse direction.

	As Welded
Yield Point psi	114,000
Tensile Strength psi	123,500
% Elongation in 2"	20.5

C	Mn	Si	Mo	V	Ni
.06	1.04	.34	.98	.27	1.76

RECOMMENDED AMPERAGE AND

diameter		1/8"	
length		14"	
amperes	flat	120-170	16
	vertical	90-120	11
	overhead	100-130	13
volts		23-24	2

E 12020 G SW-101

A mineral type of electrode for both deep g and horizontal fillet welds in high-tensile st

PROCEDURE: Preheat to 350° to 450°F and m welding is completed. Immediately follow plete heat treatment as required. For flat w tion of travel. Hold short to medium arc. Fo 15° in direction of travel bisecting the v short arc.

	As Welded	Stress Relieved	Heat* Treated
Yield Point psi	111,300	124,400	124,450
Ten. Strength psi	129,400	131,850	133,150
% Elong. in 2"	14.5	17.5	17.5

*Heat Treatment — Heat at 1650 F for 2 hours, oil quench, temper at 1165 F for 2 hours, air cool.

RECOMMENDED AMPERAGE AND

diameter		1/8"	5/32"
length		14"	14"
amperes		120-150	160-185
volts		26-28	28-30

MATION ON BEST

MILD STEEL

SW-12 **ac—dc straight**

d on poor fit-up. Designed as a "hot" E-6012
ons where the upper end of the amperage

ship bulkheads • shaft tunnels • machinery
gears • tanks and headers • machinery of

rc or lightly touch coating to work, using
does not stick. Tilt electrode 5° to 15° in
ertical welding, weld from the bottom up.

Stress Relieved

64,100	C	Mn	P	S	Si
74,800	.07	.30	.022	.025	.20
19.0					

MPERAGE AND VOLTAGE RANGE:

5/32"	3/16"	1/4"
14"	14"	18"
160-185	200-240	280-330
140-165	160-185	
140-160	160-185	
25-26	26-27	26-27

MILD STEEL

E 6012 **SW-17** **ac—dc straight**

A high rutile type electrode for heavy production welding, where fit-up is poor and high ductility and high mechanical properties are desired. Can be used with high amperages.

Built-in toughness is one of its outstanding characteristics. Ideal for high production work because higher amperage can be used. It is used at welding currents 30 to 40 amps higher than ordinary E 6012 electrodes.

PROCEDURE: For flat welds tilt electrode 5° in the direction of travel, hold medium to short arc. For horizontal fillets tilt electrode 5° to 10° in direction of travel at angle bisecting vertical and base plate. Hold medium to short arc.

	As Welded	Stress Relieved	C	Mn	P	S	Si
Yield Point psi	61,450	55,200					
Tensile Strength psi	71,950	66,600	.07	.35	.021	.027	.10
% Elongation in 2"	26.0	27.5					

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter	1/8"	5/32"	3/16"	7/32"	1/4"	
length	14"	14"	14"	18"	18"	
amperes	120-150	160-195	210-275	260-340	290-400	
volts	25-27	26-28	27-29	28-30	28-30	

E 6012

A high rutile, high p
where weld cracking
PROCEDURE: May be
however, will permi
For best results hol
direction of travel. F
a small bead is desir
bead before welding

Yield Point psi -
Tensile Strength psi -
% Elongation in 2"

RECOMM

diameter	1/8"
length	14"
amperes flat	120-140
amperes vertical	110-120
amperes overhead	110-120
volts	24-25

IRON POWDER

SW-44 **ac—dc straight**

iron powder bearing, mineral-type elec-
on horizontal and downhand welding. Pro-
to eliminate overwelding. Excellent bead
slag. Large fillets (up to 5/16") can be made

ould be used on horizontal and downhand
in direction of travel and 40° to 50° from
ary.

As Welded
75,000
87,500
25.0

Si
.80

Complies with:
A. B. S. — E 70-6024

MPERAGE AND VOLTAGE RANGE:

	3/16"	7/32"	1/4"
	18"	18"	18"
20	250-280	300-340	350-400
5	36-38	37-39	38-40

LOW HYDROGEN

E 70-6016 **MIL-7016** **SW-65** **ac—dc reverse**

A lime ferritic electrode particularly adaptable for welding steels of high sulphur content and steels of poor weldability. Also used for welding low alloy and high carbon steels without preheating, and steels that are to be enameled after welding. In many cases, it will solve cracking, porosity and similar problems encountered with regular mild steel electrodes.

PROCEDURE: Tilt electrode 5° to 15° in direction of travel. Hold short arc. Use weaving or beading technique. Important to clean crater. Restrike in center. Move back toward previous bead. Then reverse direction and continue.

	As Welded	Stress Relieved
Yield Point psi	64,450	63,150
Tensile Strength psi	74,300	72,350
% Elongation in 2"	32.0	32.5

X-Ray Quality

Complies with:
U. S. N. Type MIL-7016, MIL-E-18038
A. B. S. — E 70-6016
U. S. Coast Guard

C	Mn	P	S	Si
.08	.79	.021	.017	.23

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter		3/32"	1/8"	5/32"	3/16"	7/32"	1/4"
length		12"	14"	14"	14"	18"	18"
amperes	flat	80-100	120-170	160-200	195-260	260-310	280-350
amperes	vertical	70-100	90-120	110-140	140-170		
amperes	overhead	70-100	100-130	130-160	170-200		
volts		22-23	23-24	24-25	25-26	26-27	26-28

E 7016G

A 1.0% nickel elect
cellent manipulativ
ductile weld metal.
PROCEDURE: Tilt elec
Use weaving or bea
restriking. Restrike
bead. Then reverse

Yield Point psi -
Tensile Strength psi -
% Elongation in 2"

RECOM

diameter	
length	
amperes flat	
amperes vertical	
amperes overhead	
volts	

LOW HYDROGEN

5 **SW-120** **dc reverse**

-treated cast armor and high tensile-low
a heavy, low hydrogen type coating that
usually high ductility in the as-welded

15° in direction of travel. Hold short arc.
que. Important to clean crater before re-
crater and move back toward previous

Welded
114,000
123,500
20.5

Ni
1.76

X-Ray Quality

Complies with:
U. S. N. — MIL-E-986 — MIL-260

PERAGE AND VOLTAGE RANGE:

	32"	3/16"
	14"	14"
	160-200	195-260
	140-140	140-170
	130-160	170-200
	24-25	25-26

LOW HYDROGEN IRON POWDER

E 70-6018 **MIL-7018** **SW-47** **ac—dc reverse**

An all-position electrode which combines the advantages of low hydrogen for welding difficult-to-weld steels, and iron powder with its ease of handling, reduction of starting porosity and higher deposition rates.

PROCEDURE: Tilt electrode 5° to 15° in direction of travel. Use weaving or beading technique, cleaning craters before restriking. Restrike electrode ahead of crater and move back to previous bead.

	As Welded	Stress Relieved
Yield Point psi	70,000	65,000
Tensile Strength psi	82,500	77,000
% Elongation in 2"	33.0	35.0
Stress relieved at 1150 F		

X-Ray Quality

Complies with:
A. B. S. — E 70-6018
U. S. Navy — MIL-7018, MIL-E-19322

C	Mn	P	S	Si
.08	.72	.013	.020	.80

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter		3/32"	1/8"	5/32"	3/16"	7/32"	1/4"	5/16"
length		12"	14"	14"	14"	18"	18"	18"
amperes	flat	90-110	120-160	190-220	230-270	290-330	340-380	425-475
amperes	vertical	70-90	110-140	130-170	165-180			
amperes	overhead	80-100	120-140	130-170	165-180			
volts		19-23	20-21	21-22	22-23,	23-24	23-24	24-25

E 8018 C3

A 1% nickel electro
powder low hydro
ments to produce
notch toughness.
PROCEDURE: Tilt ele
or beading techniq
trode ahead of cra

Yield Point psi -
Tensile Strength psi
% Elongation in 2"
V-Notch Charpy
ft. lbs. @ —40 F
*Stress relieved at 1150
nace cooled.

RECOM

diameter	1/8"
length	14"
amperes flat	120-15
amperes vertical	110-14
amperes overhead	120-14
volts	22-23

LOW ALLOY — HIGH TENSILE

SW-101 **ac—dc straight**

both deep groove welding and positioned
gh-tensile steels.
°F and maintain this temperature until
ly follow with stress relieving or com-
For flat welds—tilt 5° to 15° in direc-
um arc. For horizontal fillets—tilt 5° to
ing the vertical and base plate. Hold

Treat

X-Ray Quality

	Mn	P	S	Si
2	.50	.022	.026	.20

hours,	Cr	Ni	Mo	V
rs, air	.42	1.71	.72	.16

ERAGE AND VOLTAGE RANGE:

	3/16"	1/4"
	14"	18"
	200-230	280-310
	30-32	32-34

CAST IRON

ESt **SW-5** **ac—dc reverse**

An inexpensive steel shielded-arc electrode designed especially for welding any type of cast iron when machinability is not required. Extremely good arc characteristics permit use of low amperage, thus reducing the usual hardened zone along the line of fusion. This low heat also lessens the admixture of cast iron.

Widely used for foundry repairing of malleable castings before anneal • build-up and repair of gray iron • cracked cast iron boiler sections • cracked cylinder heads and blocks.

PROCEDURE: Work should have oil, paint, grease and dirt removed before welding.

diameter	1/8"
length	14"
amperes	80-100
volts	21-23

ENi

A flux-coated elec
cast iron when sou
tionally smooth w
about the same as
metal is excellent.
giving a strong fus
removed. Weld me
not spall out. Wid
worn parts • filling
cuts and casting fl
PROCEDURE: Can be
In cold weather,
machining require
ed. It is also advi
with a blanket or

diameter	3/32"
length	14" c.g
amperes	50-90

SELLING A. O. SMIT

MILD STEEL

SW-29 ac—dc straight

...high pro... electrode especially adaptable for welding ...cracking ... problem. Also good for poor fit-up work. ...May be ... with either polarity on dc. Straight polarity, ...ll permit ... greater speeds with a lower spatter loss. ...ults hold ... are with the electrode tilted 5° to 15° in ...travel. For ... welding weld from the bottom up. Where ... is desired ... welding may be done vertical down. Clean each ...welding ... pass.

	As Welded	Stress Relieved	C	Mn	P	S	Si
- -	65,300	64,100	.07	.30	.022	.025	.20
psi -	76,000	74,800					
2" -	17.5	19.0					

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

	1/8"	5/32"	3/16"	7/32"	1/4"	5/16"
	14"	14"	14"	18"	18"	18"
	120-140	160-185	200-240	260-310	280-330	380-440
	110-120	140-165	160-185			
	110-120	140-160	160-185			
	24-25	25-26	26-27	26-27	26-27	26-28

MILD STEEL

E 6013 SW-15 ac—dc

Finest universal, high-production electrode in industry with range of applications from light gauge to heavy plate. High heat and speeds can be used without undercut. Slag easy to clean and in vertical, overhead or flat work on heavy plate, the slag will peel off weld by itself.

PROCEDURE: For flat welds — tilt 5° to 10° in direction of travel. Medium arc. Horizontal fillets — tilt 5° to 15° in direction of travel at angle bisecting vertical and base plate. Arc of medium to short length. Vertical up — use a weaving "U" or "V" arc motion, hold medium to short arc. Overhead — use circular motion. Medium to short arc.

	As Welded	Stress Relieved
Yield Point psi - - -	67,900	65,000
Tensile Strength psi - -	76,400	72,700
% Elongation in 2" -	21.5	24.5
X-Ray Quality		

Complies with:
A. B. S. — E 6013
U. S. Coast Guard
Lloyds Register of Shipping

C	Mn	P	S	Si
.10	.54	.020	.027	.45

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

	3/32"	1/8"	5/32"	3/16"	7/32"	1/4"	5/16"
diameter	12"	14"	14"	14"	18"	18"	18"
amperes flat	70-80	120-135	160-180	200-250	280-320	300-360	370-410
amperes vertical	60-75	120-130	145-175	170-185			
amperes overhead	60-75	120-135	150-180	180-200			
volts	21-23	23-25	25-27	26-28	27-29	30-31	30-32

E 6013

All position... gauges. Part... Ideal on lig...

PROCEDURE: ... Horizonal fil... vertical and... travel. Hold...

Yield Point psi ...
Tensile Strength ...
% Elongation in ...

C	Mn
.10	.42

diameter	
length	
amperes flat	
amperes vertical	
amperes overhead	
volts	

LOW HYDROGEN

SW-84 ac—dc reverse

...kel electrode with low hydrogen type coating, producing ex...nipulative characteristics and depositing sound, extremely ...d metal. The bead is uniform and slag is easily removable. ...Tilt electrode 5° to 15° in direction of travel. Hold short arc. ...g or beading technique. Very important to clean crater before ...Restrike in center of crater and move back toward previous ...reverse direction and continue.

	As Welded	Stress Relieved	X-Ray Quality C	Mn	P
- -	71,250	66,100	.08	.77	.015
psi -	80,700	75,200	S	Si	Ni
n 2" -	31.5	34.0	.017	.20	.96

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

	5/32"	3/16"	1/4"
	14"	14"	18"
	160-200	195-260	280-350
	110-140	140-170	
	130-160	170-200	
	24-25	25-26	26-28

LOW HYDROGEN

E 7016 A1 SW-79 ac—dc reverse

For all-position welding of carbon-moly and low alloy-high tensile steels. This 0.50 molybdenum electrode has a low hydrogen type coating. Arc action is quiet, stable and easy to handle. Bead appearance is uniform; slag is easily removable. Weld metal deposited is sound and extremely ductile.

PROCEDURE: Tilt electrode 5° to 15° in direction of travel. Hold short arc. Use weaving or beading technique. Very important to clean crater before restriking. Restrike in center of crater and move back toward previous bead. Then reverse direction.

	As Welded	Stress Relieved	X-Ray Quality C	Mn	P
Yield Point psi - - -	68,100	73,000	.08	.60	.020
Tensile Strength psi -	81,100	84,500	S	Si	Mo
% Elongation in 2" -	27.0	29.5	.025	.29	.57

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

	5/32"	3/16"	1/4"
diameter	14"	14"	18"
amperes flat	160-200	195-260	280-350
amperes vertical	110-140	140-170	
amperes overhead	130-160	170-200	
volts	24-25	25-26	26-28

E 8016 C1

A 2.0... nick... duces a sm... in fabricati... and high-im...

PROCEDURE: ... Use weaving... striking. Re... bead. Then...

Yield Point psi ...
Tensile Strength ...
% Elongation ...

diameter	
length	
amperes flat	
amperes vertical	
amperes overhead	
volts	

LOW HYDROGEN IRON POWDER

MIL-8018 SW-818 ac—dc reverse

...l electrode combining the manipulative advantages of the iron ...r hydrogen coating with the correct balance of alloying ele... ...roduce 80,000 psi minimum tensile with high ductility and ...ness.

...Tilt electrode 5° to 15° in direction of travel. Use a weaving ...technique, cleaning craters before restriking. Restrike elec... ...d of crater and move back to previous bead.

	As Welded	Stress Relieved*	X-Ray Quality C	Mn	Si	P
- -	80,000	79,500				
h psi -	91,500	91,800	0.07	0.80	0.74	0.013
in 2" -	22.0	20.0				
			S	Ni		Mo
Y —40 F -	37.0	26.0	0.020	0.90		.18

*Stress relieved at 1150 F for two hours, furnace cooled.

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

	1/8"	5/32"	3/16"	7/32"	1/4"
	14"	14"	14"	18"	18"
	120-150	180-220	230-270	290-320	330-370
	110-140	140-170	160-180		
	120-140	140-170	170-190		
	22-23	22-23	22-23	23-24	23-24

LOW HYDROGEN IRON POWDER

E 10018 MIL-10018 SW-1018 ac—dc reverse

Combines the manipulative advantages of iron powder low hydrogen coating with the correct balance of alloying elements to produce 100,000 psi minimum tensile deposits with high ductily and notch toughness.

PROCEDURE: Tilt the electrode 5° to 15° in the direction of travel. Use a weaving or beading technique, clearing craters before restriking. Restrike electrode ahead of crater and move back to previous bead.

	As Welded	Stress Relieved	X-Ray Quality C	Mn	Si	P
Yield Point psi - - -	92,300	102,000				
Tensile Strength psi -	93,500	103,000	0.06	1.12	0.70	0.013
% Elongation in 2" -	23.0	22.0				
V-Notch Charpy						
ft. lbs. @ —65 F -	46.0	41.0	S	Ni	Mo	V
Stress relieved at 1150 F for two hours, furnace cooled.			0.020	1.64	0.25	0.08

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

	3/32"	1/8"	5/32"	3/16"	7/32"	1/4"	5/16"
diameter	12"	14"	14"	14"	18"	18"	18"
amperes flat	90-110	120-150	180-220	230-270	290-320	330-370	425-475
amperes vertical	70-90	110-140	140-170	160-180			
amperes overhead	80-100	120-140	140-170	170-190			
volts	19-23	22-23	22-23	22-23	23-24	23-24	24-25

E 7010 A1

High-tensile... tration. For... and creep r...

PROCEDURE: ... electrode ti... motion, hes... or weave m...

Yield Point psi ...
Tensile Strength ...
% Elongation ...

C	Mn
.09	.47

diameter	
length	
amperes flat	
amperes vertical	
amperes overhead	
volts	

CAST IRON

SW-Nickel ac—dc reverse

...ed electrode with a high-nickel core developed especially for ...when sound, machinable welds are required. The arc is excep... ...mooth with practically no flutter or spatter. Arc length is ...same as it would be for mild steel. Fluidity of the deposited ...xcellent. It "w... hes" evenly up against the sides of the joint, ...rong fusion w... low peneration and heat input. Slag is easily ...Weld metal f... thoroughly with the parent cast iron and will ...ut. Widely ... for welding cracked castings • building up ... • filling out ...ersized areas • laying metal in faulty machine ...sting flaw...

...Can be use... any position, including vertical and overhead. ...eather, a mod...ate preheat of 150-250 F is desirable. When ...requirements ...e severe, a preheat of 500-700 F is recommend... ...lso advisable ... retard the rate of cooling by covering work ...nket or other ...sulating material.

RE...MMENDED AMPERAGE RANGE:

	3/32"	1/8"	5/32"	3/16"
	14" c.g.	14"	14"	14"
	50-90	90-120	120-150	130-170

CAST IRON

ENi Fe SW-Nickel 55 ac—dc reverse

SW-Nickel "55" is a flux-coated special core wire which gives exceedingly strong ductile welds which prevent cracking and spalling out particularly applicable to high phosporous cast irons and ductile irons. It offers a stable arc in all positions, smooth bead contour, excellent "wash" and very easy slag removal.

PROCEDURE: Clean work of oil, grease and dirt. Grind off "skin." Use as low a welding current as is possible. Length of arc should be about the same as that used for mild steel electrodes. Flux should be removed from each crater before making restrike, and completely removed from each pass before starting subsequent pass. Use intermittent bead method to heat evenly. Peening moderately is useful in reducing stresses. The finished weld should be cooled slowly. A blanket or other insulating material can be used. Preheating is recommended only when maximum machinability is required; when the heat developed by welding may cause cracking in other parts of the casting or when the weld must withstand pressure. A normal preheat is about 600 F.

RECOMMENDED AMPERAGE RANGE:

	3/32"	1/8"	5/32"	3/16"
diameter	14" c.g.	14"	14"	14"
amperes	50-90	90-120	120-150	130-170

TH ELECTRODES

MILD STEEL

E 6013 **MIL-6013** **SW-16** **ac—dc**

All position. Arc easy to handle with minimum of burn-through on thin gauges. Particularly adaptable for field applications on vertical down. Ideal on light gauges because of quick set-up and shallow penetration.

PROCEDURE: For flat welds — tilt 5° in direction of travel. Medium arc. Horizontal fillets — tilt 5° to 15° in direction of travel at angle bisecting vertical and base plate. For vertical down — tilt 30° in direction of travel. Hold short arc.

	As Welded	Stress Relieved
Yield Point psi	70,400	67,100
Tensile Strength psi	79,700	75,000
% Elongation in 2"	22.0	24.0

X-Ray Quality

C	Mn	P	S	Si
.10	.42	.020	.028	.35

Complies with:
Lloyds Register of Shipping
Navy MIL-E-15599

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter	3/32"	1/8"	5/32"	3/16"	1/4"
length	12"	14"	14"	14"	18"
amperes — flat	60-80	120-140	150-170	190-230	290-320
amperes — vertical	60-80	110-140	140-170	175-195	
amperes — overhead	60-80	110-140	145-170	175-195	
volts	19-22	21-23	24-27	24-27	27-29

MILD STEEL

E 6020 **MIL-6020** **SW-35** **ac—dc**

A mineral type electrode often referred to as a "hot rod" because of its high speed in downhand, horizontal or positioned fillets, flat work and deep groove welding where extreme ductility is required.

PROCEDURE: For flat welds — tilt 5° in direction of travel. Hold short arc. For horizontal fillets — tilt 5° to 15° in direction of travel, bisecting vertical and flat plate. Hold short arc, allowing the electrode coating to lightly touch the bottom plate.

	As Welded	Stress Relieved
Yield Point psi	56,600	48,900
Tensile Strength psi	63,900	59,800
% Elongation in 2"	29.0	35.5

X-Ray Quality

C	Mn	P	S	Si
.07	.32	.024	.027	.18

Complies with:
U. S. Navy — MIL-E 15599
A. B. S. — E 6020
U. S. Coast Guard
Lloyds Register of Shipping

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter	1/8"	5/32"	3/16"	7/32"	1/4"	5/16"
length	14"	14"	14"	18"	18"	18"
amperes	130-155	165-185	200-240	27-310	300-350	350-410
volts	27-29	27-29	28-30	29-31	30-32	32-34

LOW HYDROGEN

E 8016 C1 **SW-81** **ac—dc reverse**

A 2.0% nickel electrode with a low hydrogen type of coating that produces a smooth bead with an easily removed slag. Used extensively in fabrications of nickel-bearing steels that require both high-tensile and high-impact values at low temperatures.

PROCEDURE: Tilt electrode 5° to 15° in direction of travel. Hold short arc. Use weaving or beading technique. Important to clean crater before restriking. Restrike in center of crater and move back toward previous bead. Then reverse direction and continue.

	As Welded	Stress Relieved
Yield Point psi	73,200	75,900
Tensile Strength psi	82,400	85,100
% Elongation in 2"	24.5	29.5

X-Ray Quality

C	Mn	P
.08	.64	.011

S	Si	Ni
.024	.37	2.05

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter	1/8"	5/32"	3/16"	
length	14"	14"	14"	
amperes — flat	130-150	165-195	225-250	
amperes — vertical	120-130	145-165		
amperes — overhead	120-130	145-165		
volts	22-24	23-25	24-26	

LOW HYDROGEN

E 8016 B2 **MIL-52-16** **SW-90** **ac—dc reverse**

This low hydrogen electrode was developed specifically for welding 1.25% Cr-0.5% Mo steels used in high-pressure piping in power houses and similar installations.

PROCEDURE: Pre- and post-heat treat according to job specification. Tilt electrode 5° to 15° in direction of travel. Hold short arc. Use weaving or beading technique. Important to clean crater before restriking. Restrike in center of crater and move toward previous bead. Then reverse direction.

	Stress Relieved
Yield Point psi	80,600
Tensile Strength psi	91,900
% Elongation in 2"	24.5

X-Ray Quality

C	Mn	P	S	Si	Cr	Mo
.08	.63	.014	.030	.35	1.20	.54

Complies with:
U. S. N. — MIL-E-16589-52-16

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter	1/8"	5/32"	3/16"	1/4"
length	14"	14"	14"	18"
amperes — flat	120-170	160-200	195-260	280-350
amperes — vertical	90-120	110-140	140-170	
amperes — overhead	100-130	130-160	170-200	
volts	23-24	24-25	25-26	26-28

LOW ALLOY — HIGH TENSILE

E 7010 A1 **SW-75** **dc reverse**

High-tensile, cellulosic coated electrode has cutting arc with deep penetration. For carbon-moly piping or castings where high tensile strength and creep resistance at high temperatures are desired.

PROCEDURE: Horizontal and downhand — hold medium to short arc with electrode tilted 5° to 15° in direction of travel. Weave with oscillating motion, hesitating at edges. Clean each bead. From bottom up, use whip or weave motion. From top down, use stringer bead or weave.

	As Welded	Stress Relieved
Yield Point psi	67,400	65,250
Tensile Strength psi	81,400	78,500
% Elongation in 2"	21.0	29.5

X-Ray Quality

C	Mn	P	S	Si	Mo
.09	.47	.015	.015	.20	.50

Complies with:
U. S. Navy — MIL-E-15716
A. B. S.
Lloyds Register of Shipping
U. S. Coast Guard

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter	1/8"	5/32"	3/16"	1/4"
length	14"	14"	14"	18"
amperes — flat	110-130	140-180	170-190	240-300
amperes — vertical	110-120	130-180	150-190	
amperes — overhead	110-130	140-150	160-170	
volts	26-27	27-28	28-29	29-32

LOW ALLOY — HIGH TENSILE

E 7020 A1 **MIL-7020 A1** **SW-76** **ac—dc**

This high-speed molybdenum-bearing electrode specifically designed for downhand or horizontal fillet welding on low-alloy, high-tensile steels. It is used where tensile strength of 70,000-80,000 psi after stress relieving is needed.

PROCEDURE: For flat welds — tilt 5° to 15° in direction of travel and hold medium to short arc. For horizontal fillets—tilt 5° to 15° in direction of travel, bisecting the vertical and base plate. Hold short arc.

	As Welded	Stress Relieved
Yield Point psi	66,100	69,900
Tensile Strength psi	75,900	79,400
% Elongation in 2"	25.5	28.5

X-Ray Quality

C	Mn	P	S	Si	Mo
.15	.47	.025	.025	.15	.57

Complies with:
A. B. S. — E 7020 A1
U. S. Coast Guard
Lloyds Register of Shipping
U. S. Navy — MIL-E-15716

RECOMMENDED AMPERAGE AND VOLTAGE RANGE:

diameter	3/16"	1/4"	5/16"
length	14"	18"	18"
amperes	200-300	280-340	380-420
volts	33-35	34-36	37-39

Through research ...*a better way*

A.O.Smith

CORPORATION

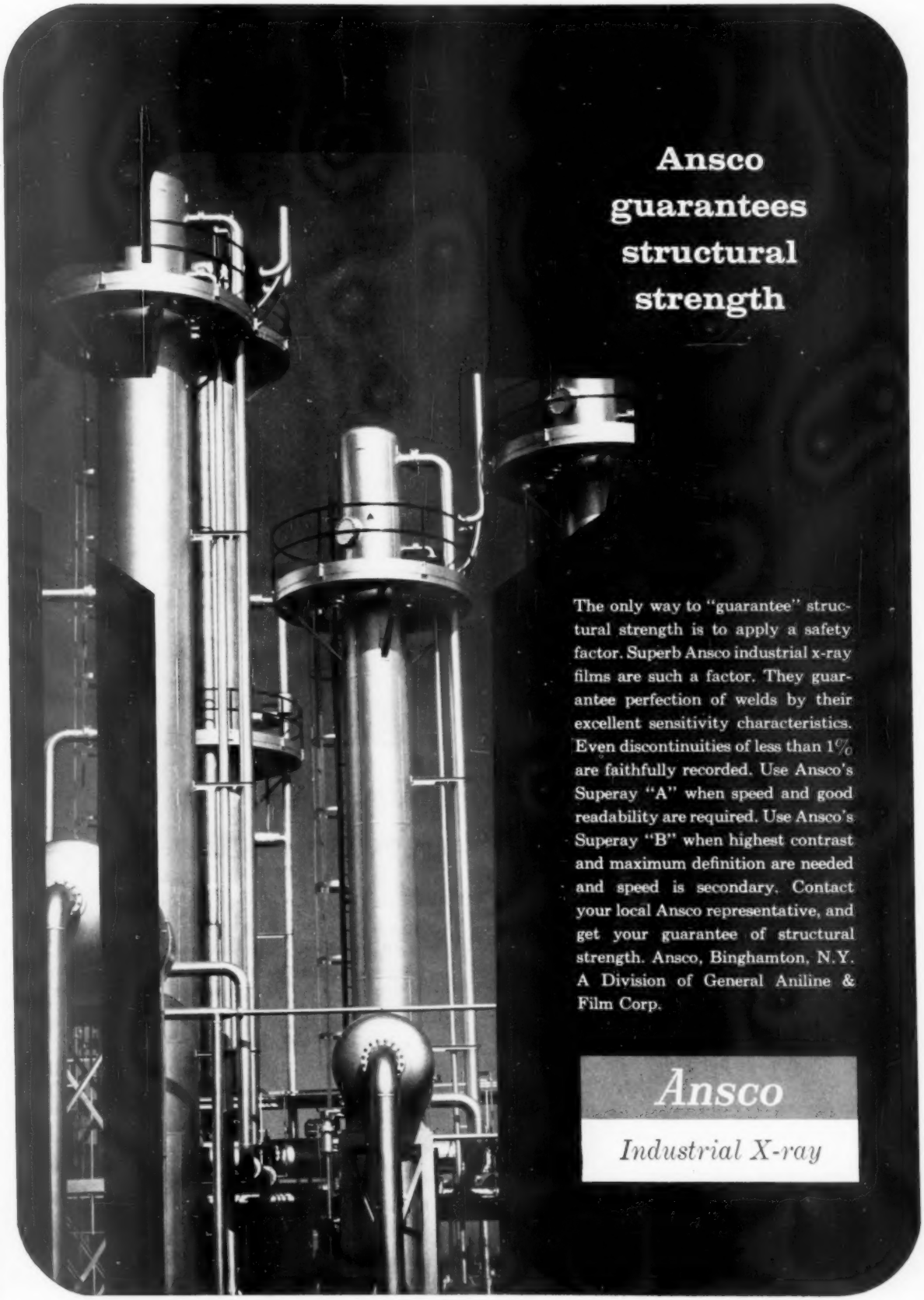
WELDING PRODUCTS DIVISION

Milwaukee 1, Wisconsin

A. O. Smith INTERNATIONAL S. A. Milwaukee 1, Wis., U. S. A.

MW-230 9-51

LITHO U. S. A.

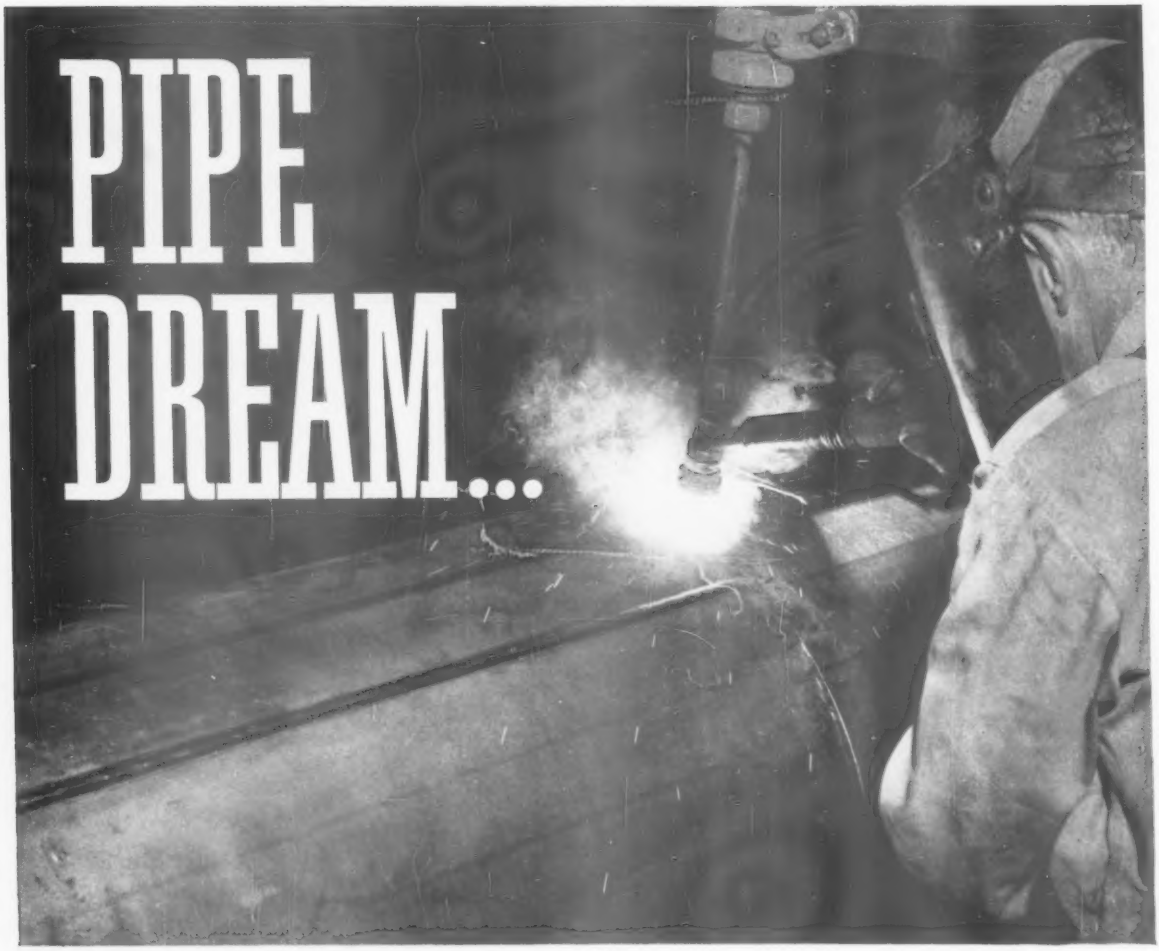


Ansco guarantees structural strength

The only way to "guarantee" structural strength is to apply a safety factor. Superb Ansco industrial x-ray films are such a factor. They guarantee perfection of welds by their excellent sensitivity characteristics. Even discontinuities of less than 1% are faithfully recorded. Use Ansco's Superay "A" when speed and good readability are required. Use Ansco's Superay "B" when highest contrast and maximum definition are needed and speed is secondary. Contact your local Ansco representative, and get your guarantee of structural strength. Ansco, Binghamton, N.Y. A Division of General Aniline & Film Corp.

Ansco

Industrial X-ray



...UNIONARC Welding saves $7000 on one production run

UNIONARC Welding—LINDE's new electric welding method for steel—increased production by 300% and saved a western pipe mill $7000 on a single run of steel pipe. Replacing covered electrode methods, UNIONARC Welding is expected to save this company $150,000 a year.

UNIONARC Welding uses a continuously-fed wire electrode, magnetically coated with flux and shielded with carbon dioxide gas. It has three times the speed and weld penetration of covered electrode welding. And UNIONARC Welding gives you "finished", X-ray quality welds and low hydrogen deposits—in all welding positions.

See for yourself—ask your nearest LINDE representative to *prove* that UNIONARC Welding slashes time and labor costs over conventional methods. Call your local LINDE office today! Or write Box WE 12, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. Offices in other principal cities. In Canada: Linde Company, Division of Union Carbide Canada Limited.

Linde TRADE-MARK

UNION CARBIDE

"Linde", "Unionarc", and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

BETWEEN PASSES

the indispensable man?

We recently came across a report of a situation that leaves us a bit bewildered. Seems an aircraft and missile company has an employee who is said to be saving money for both his firm and the United States taxpayer. He has the responsibility for etching material in preparation for spot welding. He must take the etched and unmarked parts from the final batch, match them to tickets and route them to the proper destination. The parts being etched must be described comprehensively so there will be no difficulty in matching tickets to proper parts.

Finding English complicated and long in describing these parts, the employee resorted to his native Arabic, which resembles shorthand when written. According to our report, the system has paid off, with nary a part lost. Our only hope is that there is not too much backlog, for if our friend decides to head for greener pastures, who is going to read those descriptions? Talk about job insurance. . .

in this issue . . .

Several articles are devoted to "machines for production." Welding continues to be *the* process for joining metals, but welding machines are not the only production tools used to complete the fabrication cycle. Equipment necessary for production includes presses, shears, formers, benders, etc. This issue is dedicated to those partners of the welding process, which help effect the economy so identified with welding.

New to the industry are three forming methods—radiation heating, resistant heating and explosive forming. A jack-in-the-box technique is employed when forming by radiation heating. The jack—with a filament that heats up to 6,000 F in seconds—pops from its box, heats the metal to be formed and slips back a split second before the hammer hits the die.

Forming using resistant heating is accomplished by shooting an electric current through the metal, bringing it to a high temperature, briefly, as the metal is stamped. Heat is maintained for an instant, therefore not disturbing stability of metals like titanium. Explosive forming of intricate shapes is done via shock waves activated by explosive charges. (*WeldWorld*, August, 1958.)

be prepared!

According to statistics cited by Richard S. Murphy, C. I. T. Financial Corp., Cleveland, by 1968 our population will be 205,500,000, households will number 60,300,000 and personal incomes will be up to $475 billion. Murphy says these statistics point to a boom to exceed all booms. Production demands will be higher than ever.

What are manufacturers doing in preparation for the boom years to come? According to Murphy—not enough. He says that one-fourth of the machine tools in use today are 20 years old, 65% are 10 years old, and industry is doing little to remedy the situation. "In growing competition, manufacturers cannot afford old and outmoded machinery, as some of them discovered during the recessions," he said.

electronic librarian

American Society for Metals, Cleveland, is planning to have a metals information center. All types of metallurgical literature will be boiled down, coded, filed and then found by an automatic electronic selector that has been successfully tested. Operation's cost will be financed by subscription or individual charges.

Ah, Hollywood!

One of the newspaper wire services recently sent out a picture of one *Tuesday Weld* . . . Miss Weld, that is. A pulchritudinous 15-year-old, the young blond actress is touted as a possible successor to Marilyn Monroe (whom she does resemble). The *Tuesday* portion of her name is said to have resulted from her nickname of *Too-Too*, which in turn is based on her real name of *Susan*. The press service neglected what we consider the most important part of the story—is *Weld* her real name? If not, what press agent dreamed that one up? And why?

one per mile

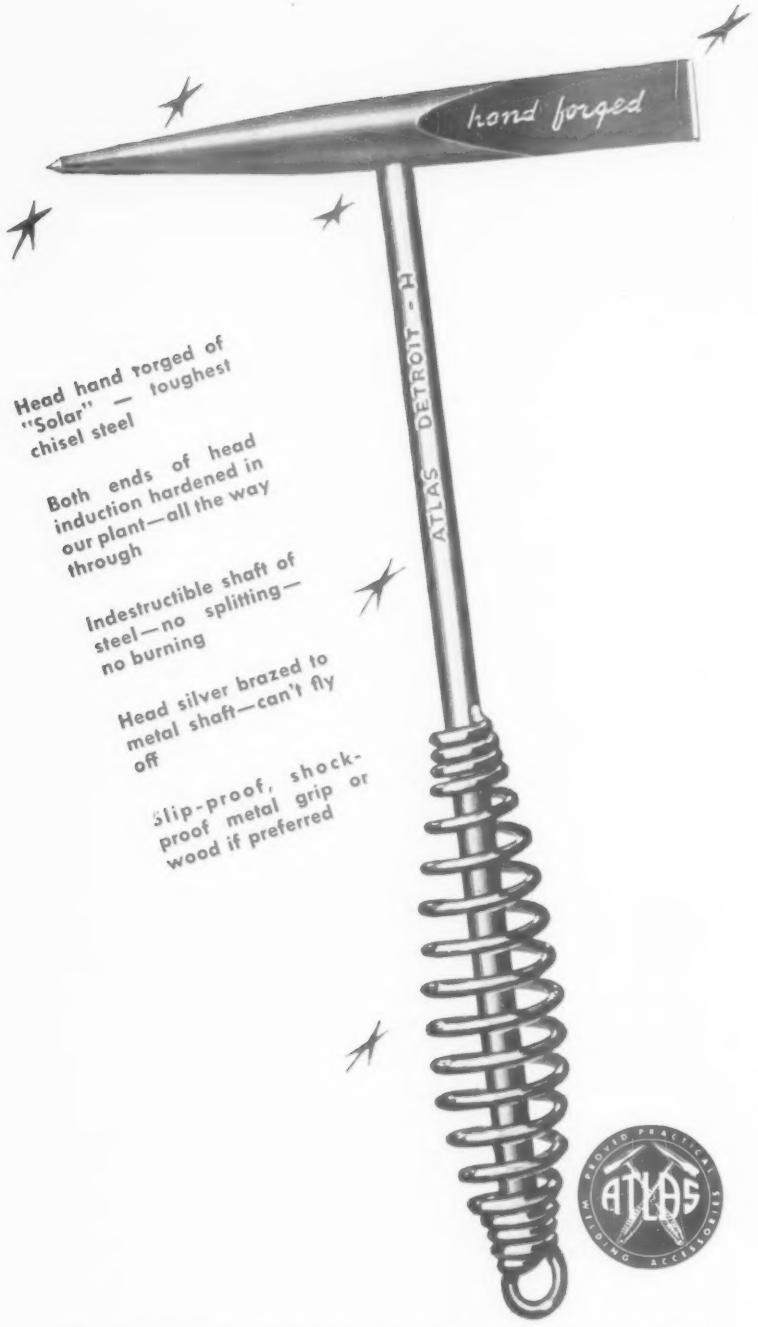
We were interested to learn that United States Steel Corp. agrees with some estimates that one bridge will be needed for each mile of the 41,000-mile system of interstate and defense highways to be built the next 15 years. To spur bridge designers to fulfill this need, the corporation and AISC are jointly sponsoring a competition with $15,000 as top award. Awards total $44,000. Professional engineers and college engineering students are eligible.

the Bard

Shop condition:
Forgot to change sprinkler fuses

. . . a sea of troubles

Hamlet, Act III, Sc 1


Head hand forged of "Solar" — toughest chisel steel
Both ends of head induction hardened in our plant—all the way through
Indestructible shaft of steel—no splitting—no burning
Head silver brazed to metal shaft—can't fly off
Slip-proof, shock-proof metal grip or wood if preferred
hand forged
ATLAS DETROIT - H
ATLAS
PROVED PRACTICAL
WELDING ACCESSORIES

YOU CAN'T BEAT ATLAS TOMAHAWKS FOR QUALITY!

Ask your welding supply dealer to show you the Atlas line of weld cleaning tools. Whatever the nature of your job there's an Atlas tool designed for it. Welders like them, their balance and feel and get better production with them.

ATLAS WELDING ACCESSORIES INC.
707 E. LEWISTON AVENUE, FERNDALE 20 (DETROIT) MICH.

Letters . . .

AWS symbols

Sir: *New York City*

I'd like to thank you for the excellent writeup on the AWS Nondestructive Testing Symbols that appeared on pages 70-72 of the October *Welding Engineer*.

Too few people are aware of the services to industry that our technical committees provide. Your article will undoubtedly help in creating an awareness of this service.

Edward A. Fenton
Technical Secretary, AWS

Welding methods

Sir: *Cleveland*

Your articles on welding engineering are excellent, but you state that there are 37 known welding methods—I can identify only 32. Would you please send me a complete list of these methods, and tear sheets covering them.

A. W. Bodin
Heil Process Equipment Corp.

—Our figure is based on the AWS master chart of welding processes which numbers 37, not including soldering.

Inspectors needed

Sir: *Baltimore*

Your description . . . of the Canadian Welding Bureau (p. 8, Nov., 1958) promoting a course on weld quality and inspection indicates a service on the part of this Bureau which could well be copied by some such organization in this country.

I say this advisably because I so often run into men supposed to be competent welding inspectors, yet who know so little about their work, I wonder who told them they could be inspectors.

Van Rensselaer P. Saxe

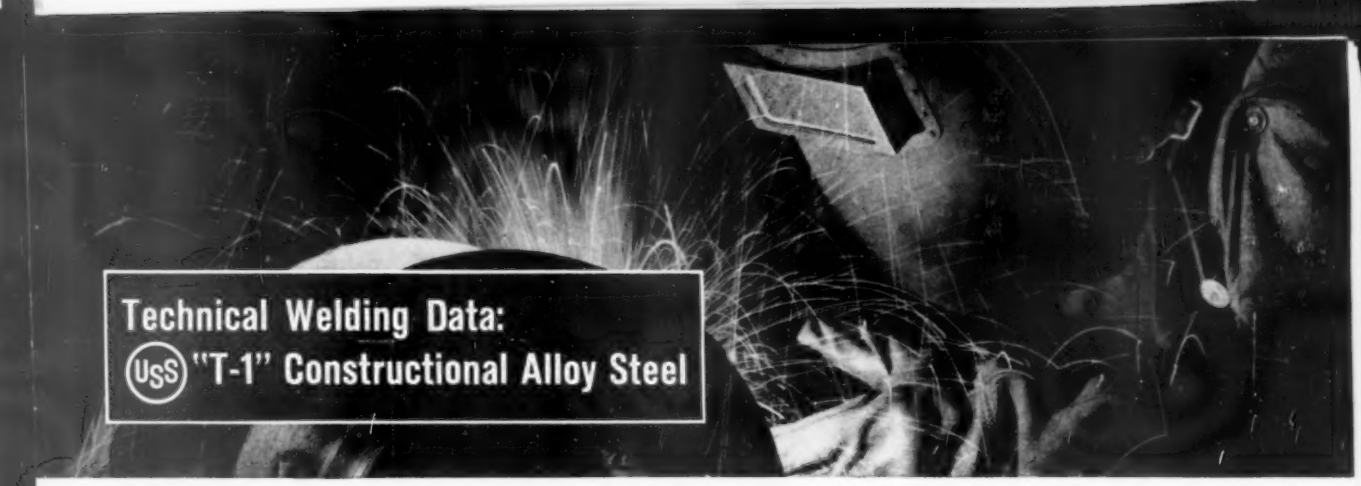
Welding development

Sir: *Albuquerque, N. M.*

Many times in the past we have found articles in your *Welding Engineer* which have contributed greatly to our progress here in the welding development laboratory, and so it was with your August issue.

The *WE* article entitled "Brazing" and Orville T. Barnett's article, "Filler metals for joining," were of great interest to this office.

L. E. Null, Welding Engineer
Sandia Corp.



Technical Welding Data:
USS "T-1" Constructional Alloy Steel

5. Welding Tests

Reported here are the results of underbead-cracking tests made on ½" plates of USS "T-1" Steel. Details of test specimens are shown in Fig. 1. Welds were made at an initial temperature of 70°F. using E-6010 and low hydrogen electrodes.

Results of cracking tests are shown in the table at right. Note that in the specimens welded with E-6010 electrodes a great amount of cracking occurs. However, the specimens welded with low hydrogen electrodes show little or no underbead cracking. It is suggested, therefore, that only low-hydrogen-type electrodes be used for the welding of "T-1" Steel.

A hardness survey of an underbead-cracking specimen welded with an E-12015 electrode is shown in Fig. 2. Note that the peak hardness obtained at the immediate junction of weld metal to parent metal is about 420 DPH. This hardness is unaffected by changes in type of electrode.

Table showing susceptibility of ½-inch thick "T-1" Steel to underbead cracking (Heat 74L236)

Per Cent of Underbead Cracking*			
Initial Plate Temp., °F	E-6010 (Cellulose Type)	E-12015 (Low Hydrogen Type)	E-9015 (Low Hydrogen Type)
0	23	3	0
70	54	1	0

Average of five tests

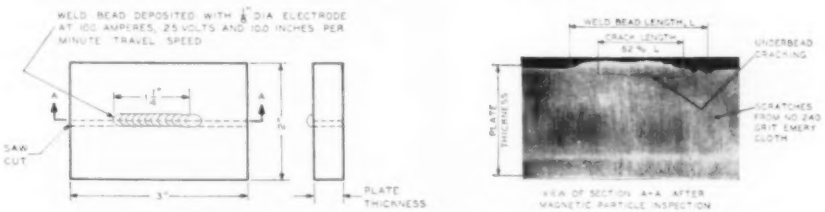

WELD BEAD DEPOSITED WITH 5/32" DIA. ELECTRODE AT 100 AMPERES, 25 VOLTS AND 100 INCHES PER MINUTE TRAVEL SPEED
SAW CUT
PLATE THICKNESS
WELD BEAD LENGTH
CRACK LENGTH
52% =
UNDERBEAD CRACKING
SCRATCHES FROM NO. 240 GRIT EMERY CLOTH
PLATE THICKNESS
VIEW OF SECTION A-A AFTER MAGNETIC PARTICLE INSPECTION

Fig. 1. Typical underbead-cracking specimen of USS "T-1" Steel welded with E-6010 electrode.

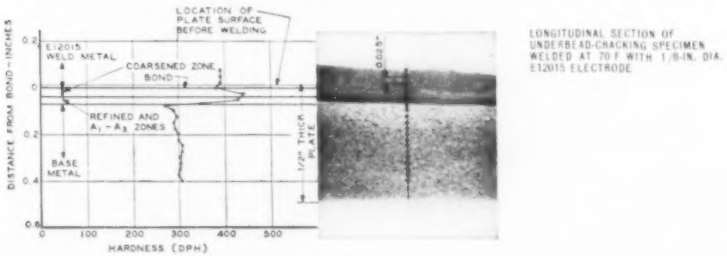

LOCATION OF PLATE SURFACE BEFORE WELDING
E12015 WELD METAL
COARSENED ZONE
BOND
REFINED AND A1 – A3 ZONES
BASE METAL
1/2" THICK PLATE
DISTANCE FROM BOND – INCHES
HARDNESS (DPH)
LONGITUDINAL SECTION OF UNDERBEAD-CRACKING SPECIMEN WELDED AT 70°F WITH 1/8-IN. DIA. E12015 ELECTRODE

Fig. 2. Results of hardness studies on an underbead-cracking specimen—½" USS "T-1" Steel.

REMEMBER THIS: No other alloy steel offers the combination of properties that "T-1" Steel possesses. Here, in just one steel, you get very high yield strength (100,000 psi minimum), extraordinary toughness, great resistance to impact abrasion, and good high temperature strength. These let you reduce the size of highly stressed parts . . . save weight, reduce the amount of welding required and cut your costs. USS "T-1" Steel is being used in bridges, excavating equipment, pressure vessels, towers . . . in equipment that must take heavy abuse in sub-freezing temperatures . . . in equipment that must withstand heavy stresses and impact abrasion at temperatures up to 900°F.

WRITE FOR COMPLETE INFORMATION about the application and fabrication of USS "T-1" Steel. United States Steel, Room 2801, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company

United States Steel

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Weldynamics

ARC WELDING AT WORK CUTTING COSTS

Completely automatic welding . . . guided by hand with the "Mechanized Squirt Welder"

Here's how you can get the speed and sureness of automatic welding . . . plus portability and versatility never before heard of in submerged arc welding.

Mechanized gun is propelled at any preset speed while electrode and flux are fed from an all day supply on the compact, portable control unit.

- Accurately controlled speeds from 1 to 70 inches per minute.
- Flux and wire supplies allow many hours of continuous welding.
- Guides in any direction without fixtures.
- Deep penetration of submerged arc welding.
- Easy to make beautiful welds.
- High operator appeal—light gun, no helmet.

TRIGGER — Single trigger starts and stops flux flow, wire feed, and welding current.
SPEED CONTROL AND REVERSING SWITCH — Speed control dial calibrated in inches per minute. Can be changed while welding. Reversing switch determines direction of travel.
TRAVEL MOTOR AND DRIVE WHEEL — Propels gun in any direction at desired speed.
ELECTRODE — (5/32" or 3/16") — Feeds continuously from 60 lb. coil in control unit through extra flexible cable.
MOTOR MOUNT — Travel motor easily adjusted up or down to control flux coverage and rotated around the gun to change travel direction. Control wire coupling disconnects for quick removal of entire travel mechanism for manual operation.
FLUX — Granular flux feeds through tube from tank on control unit to small reservoir on gun. Flows from gun by gravity as needed.

PORTABLE CONTROL UNIT (not shown) — *Contains arc voltage and inching speed controls as well as meters for welding current and voltage. Unit also mounts 60 lb. coil of electrode and tank for over 100 lbs. of flux. Entire control system operates on 115 volt AC power.*

The World's Largest Manufacturer of Arc Welding Equipment

LINCOLN

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THE LINCOLN ELECTRIC COMPANY, DEPT. 1748, CLEVELAND 17, OHIO

DECEMBER, 1958

Welding Engineer

ESTABLISHED 1916

Good will toward men

DECEMBER MEANS MANY things to many people. To most it's a holiday season characterized by one phrase, "Peace on earth, good will toward men." But the season won't be marked with peace this year: belligerent factions throughout the world have seen to that.

And probably the best reason for this world-wide unrest is our frequent neglect of the second half of this time-honored phrase—*good will toward men.*

We don't claim that practicing good will is the panacea for which the world has been searching all these years—but we do claim this: When good will is extended, it cannot be ignored—not even by the most belligerent individual. And oddly enough, once received, good will multiplies until the receiver in turn extends it to another.

But this good will must come from within the individual, nurtured by a feeling of well-being. We're partial, of course, but we think welding has done more than its share in bringing about this feeling for millions of persons.

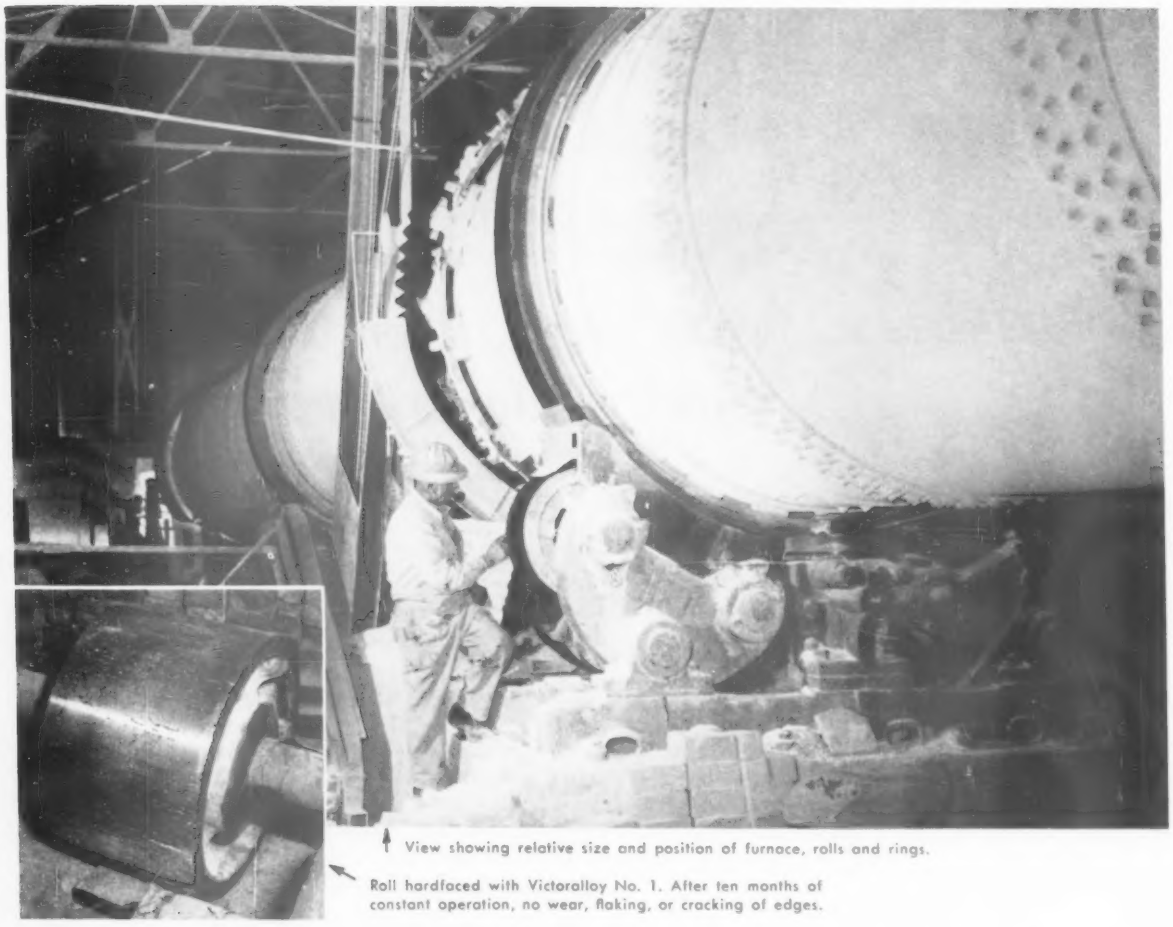
In short, we feel welding has helped and will continue to help create this basic and necessary feeling.

We who are associated with welding have seen problems solved time and again by this modern means of metal joining for both home-owners and business executives. When the boiler springs a leak, and you build a head of steam . . . when Junior's bicycle frame cracks, and the world seems to have come to an end . . . welding has soothed the frayed nerves and dried Junior's tears.

The good-looking lines of certain products; the lightness of others; and the cost savings on all welded products—these, too, are among the everyday contributions welding makes toward this feeling of well-being.

Good will toward men is something we all desire and would like to see in our lifetime—and we in the welding industry have a tremendous tool with which to work, not only through welding itself, but in our daily contacts with employees, distributors and salesmen.

Let's make use of it. Perhaps 1959 will see peace on earth because of good will toward men—which welding helped along.



View showing relative size and position of furnace, rolls and rings.

Roll hardfaced with Victoralloy No. 1. After ten months of constant operation, no wear, flaking, or cracking of edges.

A case of wear and tear... and how Victoralloy solved it

PROBLEM:

The 300-ton furnace of Diamond Springs Lime Company, Diamond Springs, Calif., rolls on 16 centered 30/40 carbon steel rolls. The furnace's heavy weight and terrific heat caused the rolls to flake and crack at the edges. This in turn caused the furnace roller-rings to begin disintegrating. How to stop the wear and tear before an expensive shutdown and complete replacement of rolls and roller-rings became necessary?

SOLUTION:

Herbert Green, superintendent, and John Desson, general foreman, hardfaced the rolls with Victoralloy No. 1 Coated-Electric. Checking after ten months of operation, they found the case solved: no flaking of rolls, no cracking at the edges, and no disintegration of furnace roller-rings.

You, too, can solve cases of wear and tear on operating parts with Victor hardfacing alloys. Complete line of 26 different alloy rods assure you a right rod for every hardfacing need. Full range of sizes for both acetylene and electric AC and DC applications, either hand or automatic. Order from your Victor dealer TODAY.

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Victor Hardfacing Manual shows you right rod to use and how to apply it. Write us NOW *for your copy.*

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H-40 **VICTOR EQUIPMENT COMPANY**

ALLOY ROD AND METAL DIVISION

13808 E. Imperial Highway, Norwalk, Calif. • Wakita, Oklahoma

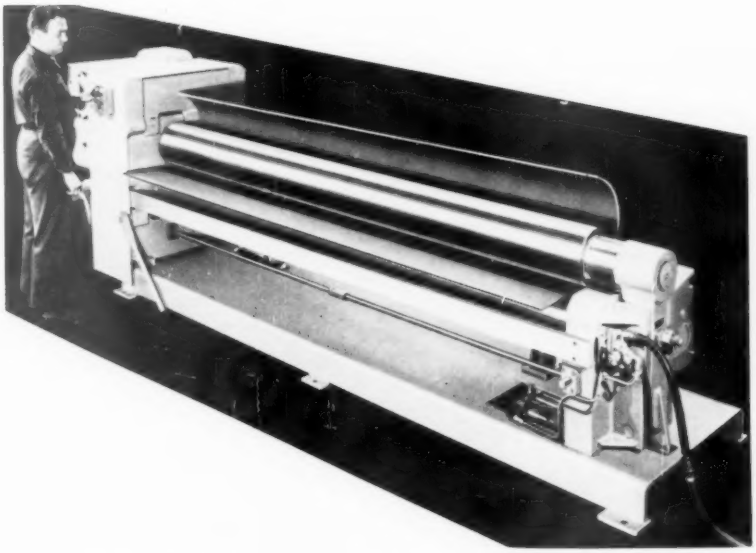
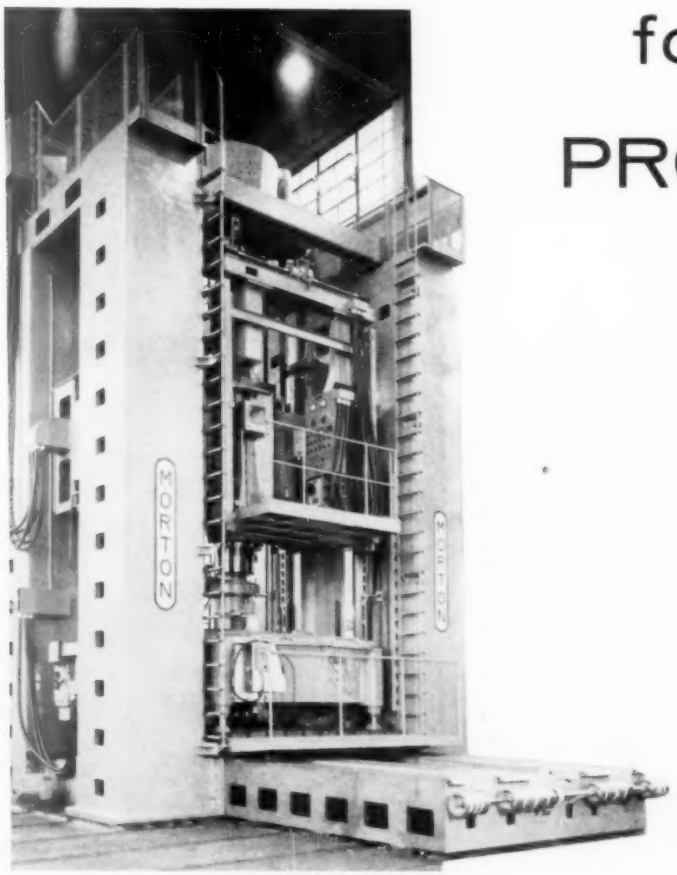


PLATE bending roll by Niagara Machine & Tool Works is welded steel unit designed to minimize deflection at maximum capacity. This model, with 9 or 10-in.-diameter rolls, features pushbutton control of starting, braking, and raising or lowering of power adjusted rear roll. Machine handles plate up to ¾ in. thick in turning out commercially true cylinders.

BELOW: Giant unit, largest ever fabricated by Morton Mfg. Co., is designed to machine high-pressure sections of large steam turbines. Welding was extensively used in fabricating the 525,000-lb monster, which is 27 ft long, 22 ft wide, 40 ft high. Closed-circuit TV, with camera rotating on spindle with tool head, gives operator close control over work. Nineteen motors with total 210-hp output power the machine. Work table is 11 ft by 13 ft and has load capacity of 120,000 lb. Spindle speed range is from 2 to 60 rpm.

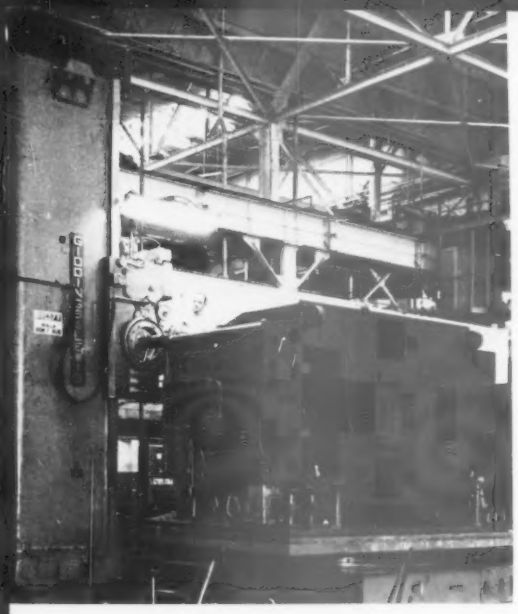


MACHINES for PRODUCTION

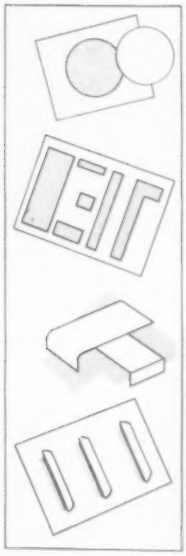
. . . the theme of WELDING ENGINEER's December issue, and an entree to many tools that give welding a valuable assist.

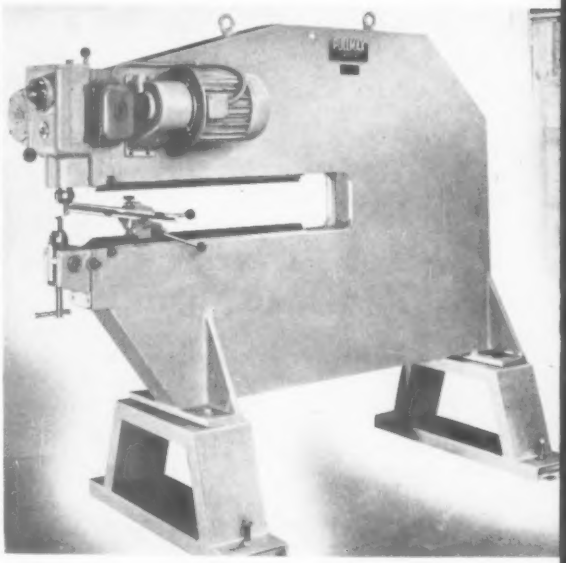
On this and four succeeding pages are just a few of the many machine types that cut, bend, stamp or position parts that will be welded—or finish them when the weldor is through.

The men who use these machines know their worth. But for those who are not as familiar with them, here's a glimpse at samples of ingenuity, craftsmanship and rugged dependability which save U. S. industry thousands of dollars every day.



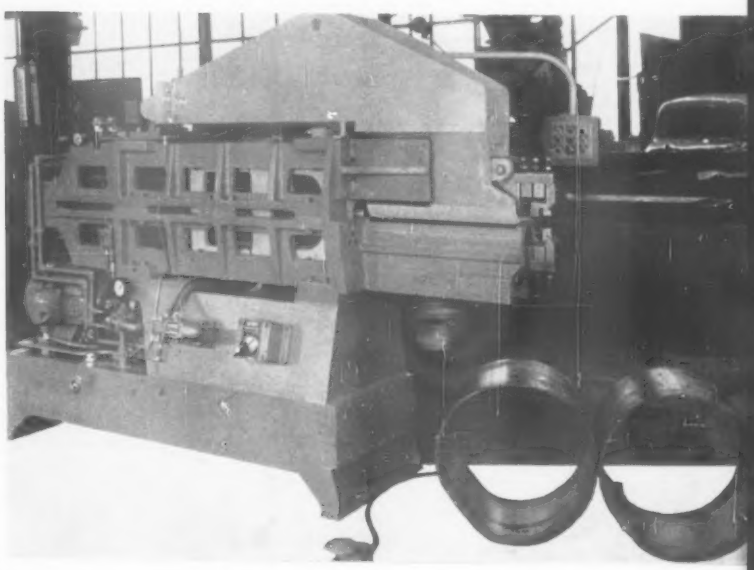
LEFT: Milling, boring and drilling machine by Giddings & Lewis is installed in plant of Verson Allsteel Press Co., where it is applied to large weldments. It is equipped with 8 ft by 10 ft rotary table which has 8 ft of in-and-out travel at right angles to machine. Column has 26-ft longitudinal travel and can machine units 16 ft above floor. Unit also has full complement of right-angle milling attachments.





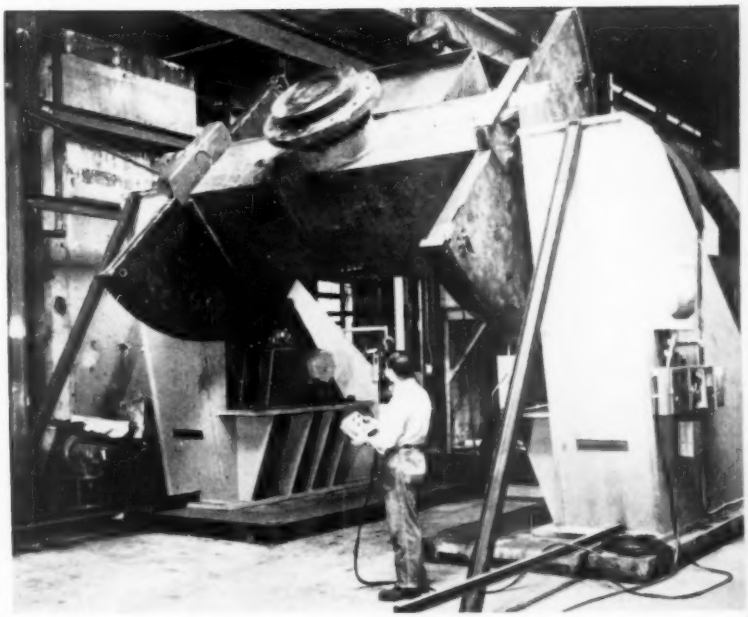
PRE-WELD multi-purpose machine by American Pullmax Co. can do straight, circular, inside, irregular, slot and louver cutting, plus beading, joggling, flanging, edge-bending, dishing and nibbling. Some common jobs handled by machine are sketched at left above. Unit has welded box-frame construction, 48-in. throat, 3-hp motor and quick-locking attachments. It has cutting capacity of 9/32-in. in mild steel, but will also handle stainless, nonferrous metals, wire mesh and many types of plastic sheet.

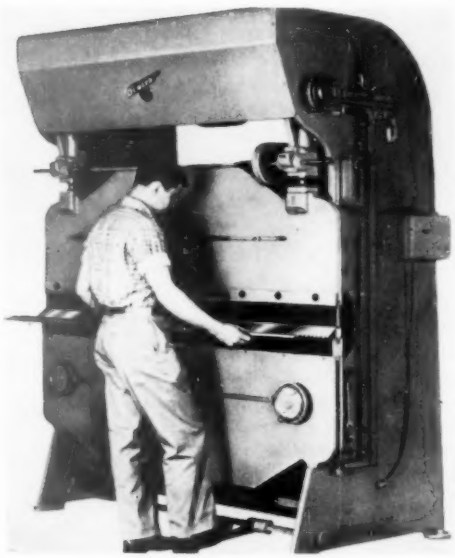
BELOW: Roll planishing machine by Airline Welding & Engineering cold-works and smooths welds on sheets, cylinders, cones, etc. Machine shown gives controlled pressures to 13,000 lb; other models range to 20,000 lb. Machine will planish cylinders or cones up to 1/8 in. thick, from 11 in. ID to 36 in. OD, and with maximum weld length of 60 in. Planishing increases weld strength, eliminates grinding, and expedites sizing, spinning and bulge forming.



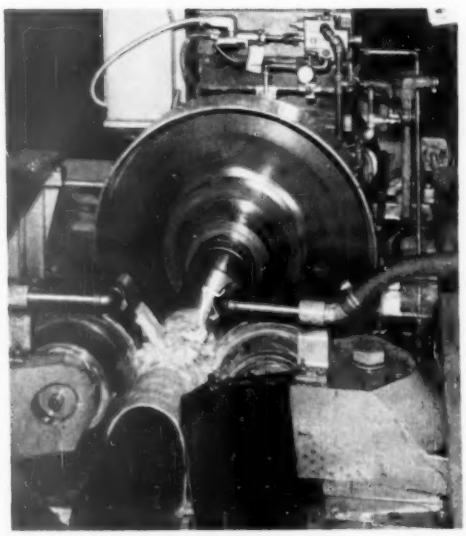
TRIMMER by Grotnes Machine Works removes surplus weld metal from one or both sides of seam; it does not planish weld. Used when weld contains foreign matter or buildup is excessive, trimming is accomplished with broach-like tool and can be done in longitudinal or rotary manner depending on machine type. Trimming is always done immediately after welding and before first forming operation.

RIGHT: Positioner by Worthington Corp. has 200,000-lb capacity at 24-in. center of gravity and 24-in. eccentricity and is one of world's largest. Made for Bucyrus-Erie of Milwaukee, unit is used to position large power shovel frames for welding. Machine has two synchronized 25-hp motors to drive tilt of 16-sq-ft table, weighs 65 tons, and stands 13 ft 9½ in. high with table horizontal.



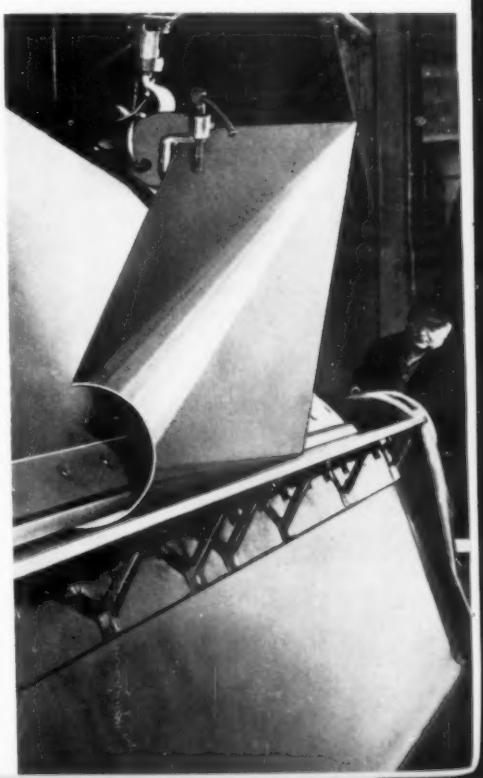


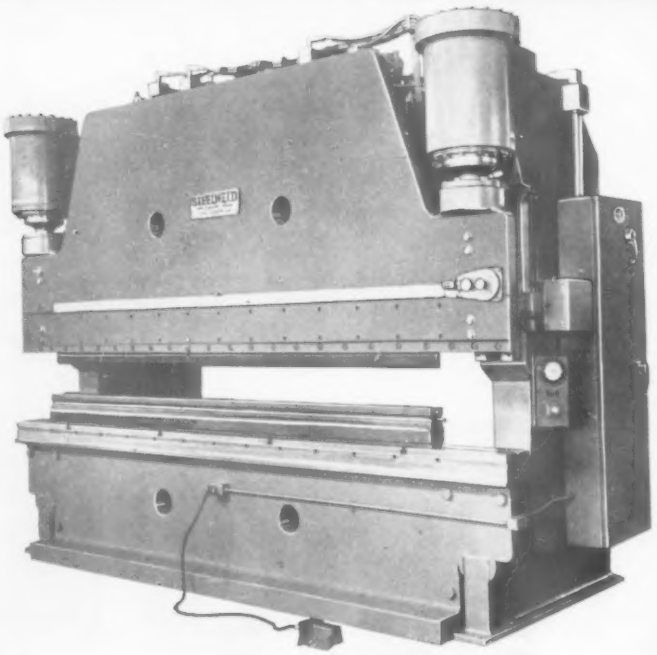
LEFT: Hydraulic 25-ton "Di-Acro" press brake by O'Neil-Irwin Mfg. Co. features adjustable stroke and dual-speed operating cycle. Stroke adjustment permits operator to pre-set ram to narrowest possible opening for each job in less than 15 seconds. During operating cycle, ram travels at fast speed to pre-set point above work, moves at slow speed with full pressure during work part of stroke, then resumes fast speed on return. In photo, 16-gage mild steel sheet is formed on unit's 6-ft bed.



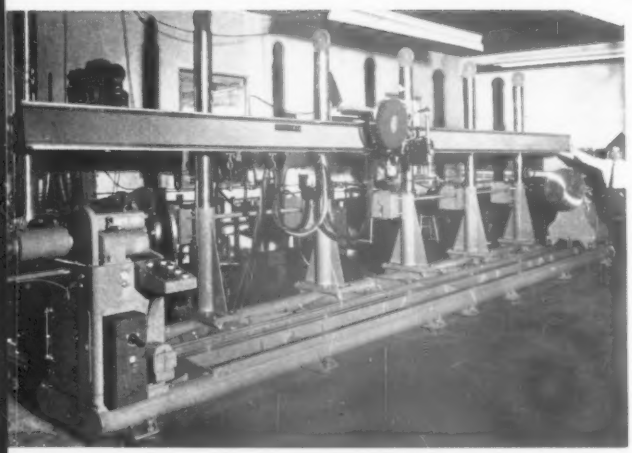
ROTOFORMING unit by Commercial Shearing and Stamping Co. will produce such shapes as straight-side cones, straight-wall tubes, curvilinear-wall shapes, and elliptical or hemispherical shapes. Carbon steels, stainless, nickel, copper, molybdenum, magnesium and titanium are among metals which can be rotoformed, in tube diameters from 2¼ in. ID to 42 in., and lengths to 100 in. Rotoforming smooths welds due to plastic deformation of metal.

RIGHT: Bending brake by Dreis & Krump Mfg. Co. handles one of two pieces in which square-to-round transition is formed. Eight partial bends are made on each conical corner by moving one end of the plate out for each bend, and holding point for square corner fixed. Completed pieces, welded together, form structure with 12-in.-diameter round end, 4-ft by 5-ft base, and 6-ft height. Forming of ¼-in. steel plate for one piece is approximately 30 minutes (floor-to-floor time).



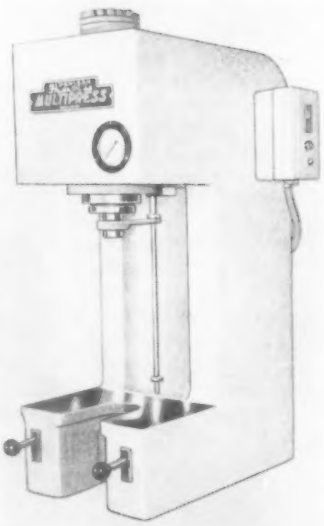


RIGHT: Hydraulic press brake by Cleveland Crane & Engineering Co. is one of several models with capacities to 2,000 tons for bending mild steel from 10 gage to 2 in. thick and in lengths to 30 ft. Press cannot be overloaded and power is constant during entire stroke. Two speeds are standard on all but smallest of these welded units, and ram can be started, stopped or reversed at any point in stroke. Operating pressure is adjustable, and either end of ram can be tapered as much as 1/8 in. per foot of ram length.

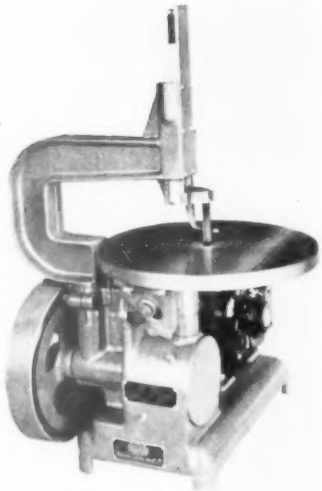


LEFT: Circumferential/longitudinal welder by Airline Welding & Engineering incorporates headstock-tailstock positioning device. It is used at Grumman Aircraft & Engineering Co. to join 6061 aluminum shells 60 in. in diameter, and with wall thickness from 1/16 to 3/32 in. Automatic welding head is carried on carriage along side beam track. Unit is adjustable to take cylinder lengths to 24 ft, and rotation speed ranges from 0.15 to 6 rpm.

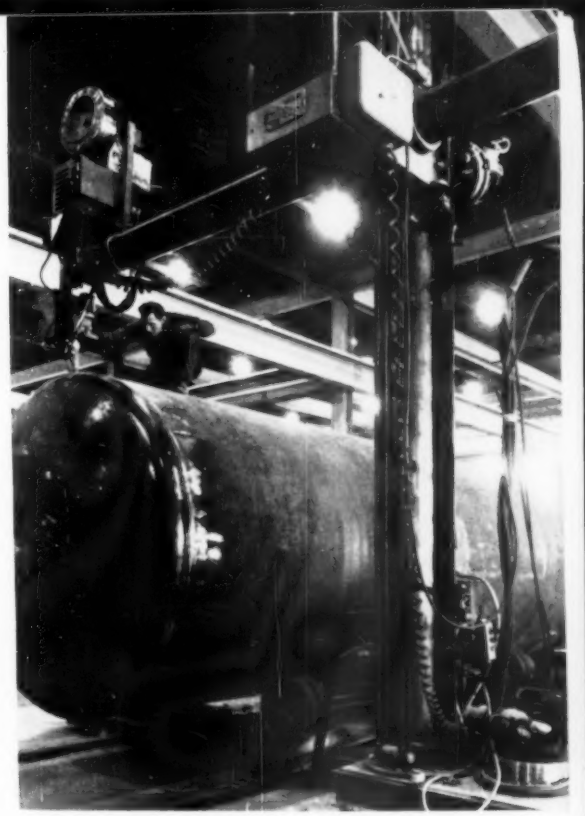
WOERNER tubular profile cutter by Nickelson Tool & Die Co., Inc., is produced in floor and bench models to handle pipe or tube to 7 in. OD. Unit can be fitted with any standard machine-cutting torch, or powder torch for cutting cast iron and nonferrous pipe. Torch carriage is mounted on ball-bearing track rollers counterbalanced against the pattern guide which determines profile shape. Welded steel unit has variable-speed transmission and is accurate to 0.015 in.



VERSATILE hydraulic press by Denison Engineering Div. of American Brake Shoe Co. can be tooled for assembly, crimping, forming, broaching, trimming and other operations. Self-contained, bench type unit (in several models) operates on 220 or 440 volts, 60 cycles, three phase current. Ram force is variable and ranges from 400 to 16,000 lb, depending on model. Press has single removable power unit for hydraulic system and can be equipped with index tables, feed hoppers, stock feeds and other accessories.

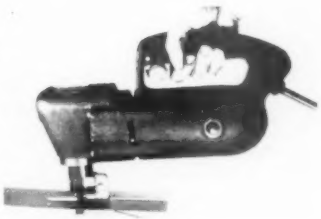


LEFT: Contour sawing, filing and lapping machine by Oliver Instrument Co. can be operated by semi-skilled workman and shapes dies and tools that do not require hand filing or other semi-finishing operations. Unit is produced in both bench and pedestal models.

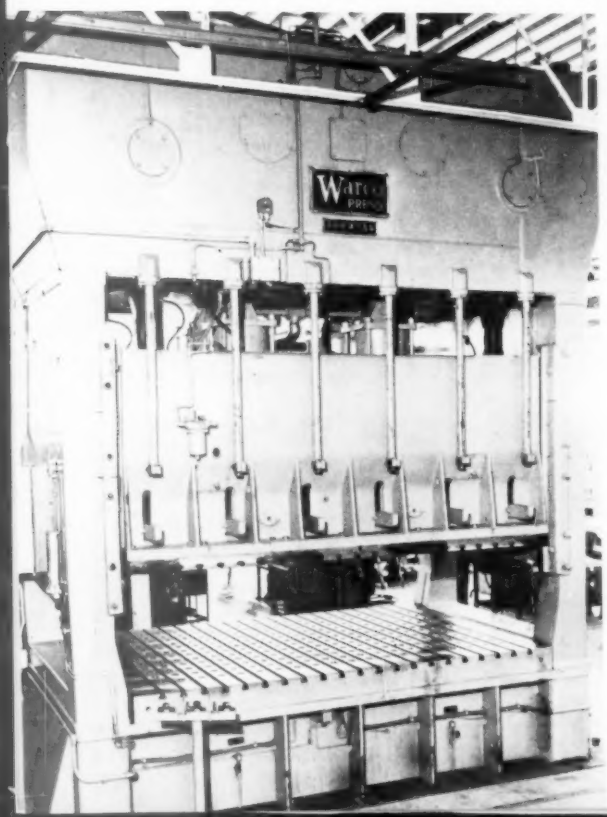


POWERED turning rolls and idlers by Unique Equipment, Inc., have 20-ton capacity—sufficient to rotate this large tank for circumferential submerged-arc weld joining cap to tank body. Powered rolls have direct worm-gear drive on both sides; wheels are rubber-tired to protect tank surface. Gear and motor mechanisms are enclosed, and reversible transmission is built-in.

RIGHT: Portable nibbler by Modern Mfg. Co., Inc., will cut woven wire, wire cloth and gasket material to 3/16 in. thick plus thin sheet metal. Unit, which can also be used in fixed position on table, operates on 110 volt, a-c or d-c.



PRESS by Federal Machine & Welder Co. is a welded steel unit designed for production runs of deep-drawn parts. It is a double back geared, four-point eccentric type with a 300-ton capacity ½ in. from bottom of stroke. Equipped with pneumatic clutch and brake with electric clutch control, press operates at 14 strokes per minute.



RIGHT: Pipe is cut and beveled in preparation for welding with this unit by H & M Pipe Beveling Machine Co. Machine, produced in seven models, will cut pipe from 1½ to 36 in. in diameter. Unit is portable and is attached to pipe with chain fasteners; it is operated by hand crank.

FIG. 1: spherical pressure vessel type fabricated for use in aircraft and missiles is one of two general vessel configurations.

FIG. 2: cylindrical pressure vessel type is also an all-welded fabrication. Spherical vessel is sometimes substituted for hemispherical head to form special combination vessel.

Tooling and welding team-up for economy

—on specialized pressure vessels

by **Gerald Garfield***

DECREASED WEIGHT . . . greater strength . . . dimensional stability . . . reliability . . . quality control . . . cost.

These design and production considerations are important to every fabricator. To the firms which plan and build pressure vessels for aircraft and missiles, such factors are not just important—they're *crucial*.

To achieve their objectives, these companies (1) use weldable, heat-treatable alloys which cut weight while boosting strength; (2) employ proper tooling to closely control vessel geometry, giving dimensional stability and reliability; (3) make extensive use of many test methods to satisfy the rigid requirements of quality control, and (4) keep close tabs on cost.

Pressure vessels for aircraft and missiles are fabricated in two general configurations: the spherical types, and the cylindrical type with a hemispherical head (see Figures 1 and 2).

Both vessel types may also be com-

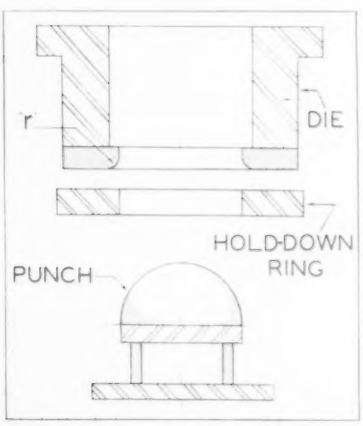
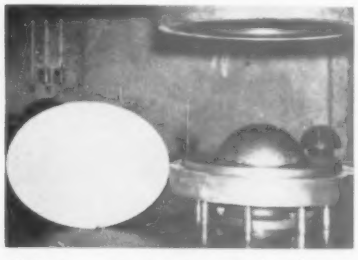
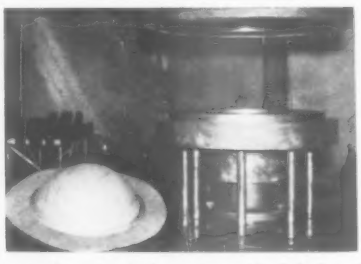


FIG. 3: components of typical deep-drawing die for forming hemispherical heads. Die as shown is suitable for use on double-action hydropress with adjustable cushion to regulate hold-down pressure. ("r" is *radius.*)

*The author is chief engineer of Research Welding & Engineering Co., Inc. This article is based on a paper delivered by Mr. Garfield to a meeting of the American Society of Tool Engineers.





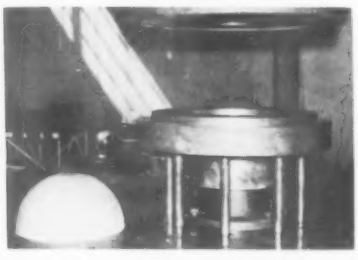


FIG. 4: progressive stages in two-draw operation to form hemisphere shows blank before forming *(left)*; after first draw *(center)*, and completed *(right)*.

bined to form a high- and low-pressure tank. The spherical unit is the high-pressure vessel in such a combination.

(The use of semi-elliptical and ASME heads in aircraft and missile pressure vessels is limited, and is confined largely to ground handling equipment.)

Hemispherical heads may be formed by deep drawing, hydroforming or spinning. The typical deep-drawing die in Fig. 3 is suitable for a double-action hydropress. If the die is used in the position shown in the sketch, however, the press must have an adjustable cushion to regulate hold-down pressure. On presses without a cushion, the die can be inverted and the hold-down ring attached to the blank holder.

One to six or more draws may be needed to complete a head, depending on type of material used and on the ratio of wall thickness to head diameter. (See Fig. 4 for a two-draw operation.) Materials with work-hardening characteristics require intermediate anneals between draws.

Several factors contribute to the maintenance of a uniform wall thickness in hemispherical heads: (*a*) blank size; (*b*) radius; (*c*) material used on die surfaces and hold-down ring where they contact blank material, and (*d*) lubricant.

Blank size is determined either by the die designer or die maker at the time of die try-out. Frequently, a blank considerably larger than needed to form the actual hemisphere is used to control uniform thinning of the material.

If design tolerance for head thickness is very close, blanks may have to be partially pre-ground to compensate for uneven thinning. A typical pre-ground blank for forming a 32-in.-diameter hemisphere is sketched in Fig. 5.

Radius ("r" in Fig. 3) depends on the metal type used for the head, and is generally over four times the thickness of the blank. If radius is increased too much, the blank area unsupported at the start of drawing is also increased and may wrinkle.

When more than one draw is required, it is sometimes necessary to round the remaining flange. This action creates a more uniform resistance to the forces drawing the material through the hold-down ring.

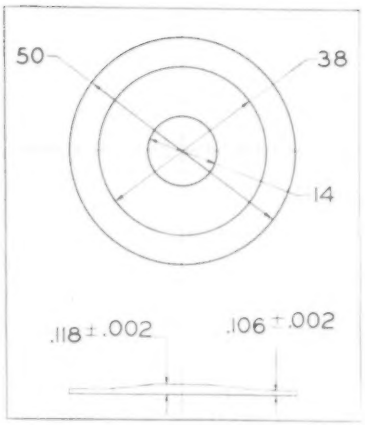


FIG. 5: top and side views of typical pre-ground blank for forming 32-in.-diameter hemisphere.

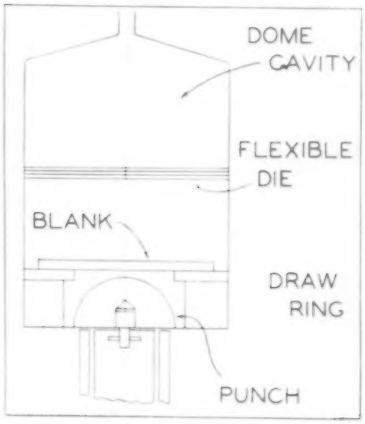
and gives more consistent thinning.

Head material being formed is the determining factor in selection of material used on the surface of the die and hold-down ring. To prevent galling of stainless steel blanks, for example, an aluminum-bronze alloy —which has a low coefficient of friction in contact with stainless—has been successfully used to make a large number of parts with almost no wear on die surfaces.

For deep-drawing such chrome-alloyed steels as SAE 4130, 4140 and 4340, the use of flame-hardened die and hold-down ring surfaces is satisfactory *if* a hardness greater than Rockwell C-50 is used on wear surfaces.

If die life is to be prolonged, lubricants must not break down during deep-drawing operations. Lubricants containing sulphur should not be used if they cannot be completely removed from the metal after forming. Traces of sulphur on certain sensitive steels will cause extreme brittleness during any subsequent heat-treating or welding operations on the steel.

FIG. 6: cut-away sketch shows major components of hydroform tooling and manner of blank placement.



Hydroform tooling utilizes a male punch and a draw ring (Fig. 6). A blank is placed on top of the draw ring, the flexible die member is lowered, pressure is applied in this die member, and the punch is moved upward into it.

Application of the hydroform method usually requires the use of a special press designed specifically for this type of forming. However, an ordinary hydropress can be used if it is fitted with a special adaptor.

The spinning method of forming hemispherical heads requires only a male spinning chuck. Plastic or metal may be used in making this chuck, but if blanks must be heated prior to spinning, a steel chuck is generally used.

The success of spin-forming hemispherical heads rests largely on the

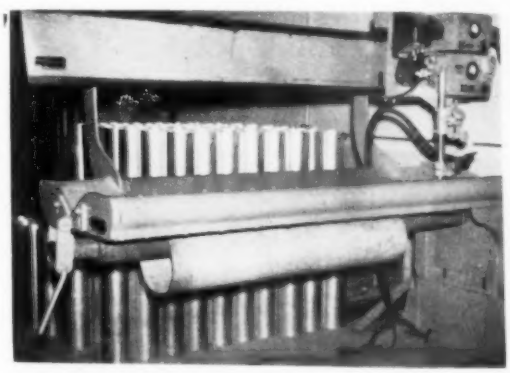


FIG. 7: fixture made by Airline Welding & Engineering Co. holds rolled plate in accurate alignment while automatic inert-gas welding head joins seam to form cylinder.

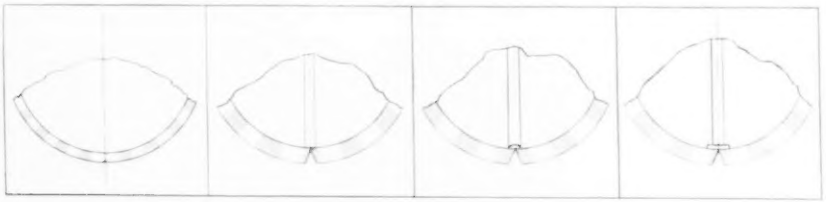


FIG. 8: four joint types commonly used in welding pressure vessels are *(from left)*: butt; V-groove with interlocked mating surfaces; V-groove with consumable backup ring; V-groove with conventional backup bar.

operator's skill. For uniform wall thickness control, special machines with a template following the spinning rollers are used.

From a design engineer's standpoint, deep-drawing is best for head forming because stresses applied on the material when drawing closely simulate the triaxial stresses on hemispherical heads when pressure is applied internally.

Cylinders for aircraft and missile pressure can be formed in several ways:

1—by rolling a flat sheet or plate and welding the longitudinal seam;

2—by utilizing special expanding mandrels;

3—by using air or hydraulic pressure.

Rolled plate can be accurately held for welding in a fixture such as that shown in Fig. 7. This unit is equipped with a beam track and travel carriage to move the welding head along the fixtured seam. Pressure for the hold-down bars which clamp the rolled plate is supplied through an air hose.

Cylinders fabricated by the rolling and welding method may have to be rolled to meet design tolerances, or they may have to be accurately rounded-out with a mandrel.

Special expanding mandrels see valuable use wherever roundness and diametrical tolerances are extremely small. These mandrels are frequently made in six or more segments, with a central tapered pin. As the pin is pushed or pulled along the segments, they expand uniformly to size the cylinder. (If material such as magnesium and its alloys must be sized, the segments can be internally heated by electricity.)

Joining heads and cylinders—or heads to each other to form a spherical vessel—involves the use of several weld joints. Four of these joint types are shown in Fig. 8, and the first three are self-aligning.

If a straight butt joint is used in some designs, and if the vessel has an access hole that is too small to permit mechanical joint alignment from the inside, a fixture similar to that shown in Fig. 9 may be used. This unit, designed and manufactured by Research Welding & Engineering, will securely hold the weld joint in perfect alignment from the outside during welding.

All completed pressure vessels are non-destructively inspected by some or all of the following methods: (1) magnetic inspection; (2) fluorescent penetrant; (3) dye penetrant, or (4) radiography. Final approval on most vessels is given only after they are hydrotested to a specific pressure.

Heat treatment is called for on most pressure vessels fabricated for missiles and aircraft. The fixtures used for this operation are generally a type that permits vessels to be submerged in a quenching fluid, and to be held there in a manner that avoids physical damage.

To prevent quenching oil from entering a vessel's interior, a snorkel tube is fitted to it. During the quench period, this tube extends above the surface of the oil and allows atmosphere to enter the interior of the vessel.

Designers and fabricators of these specialized pressure vessels know how important it is to adhere strictly to the exact geometry specified for the vessels. They know from experience that deviations can lead directly to fatigue failure.

By designing their tools and fixtures to permit the greatest possible accuracy in forming and welding, they are giving the U. S. safer aircraft and more reliable missiles.

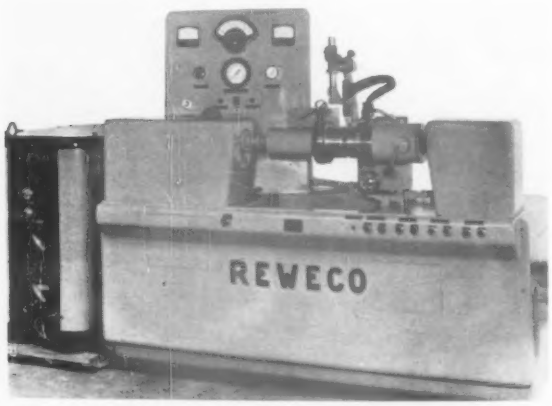
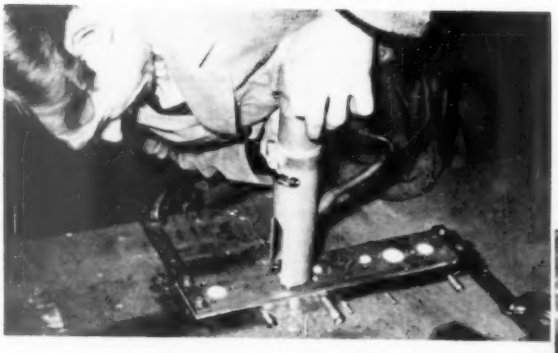
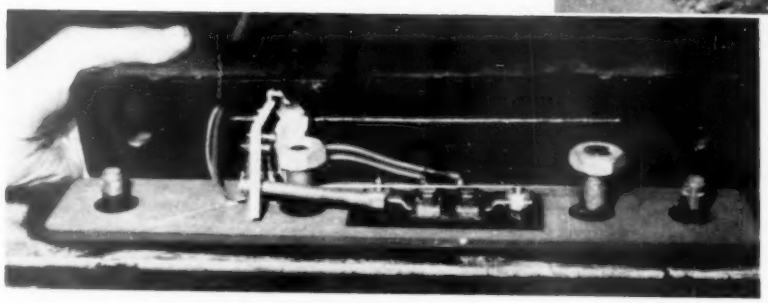


FIG. 9: fixture designed and fabricated by Research Welding & Engineering Co. is used for exterior alignment of butt-jointed vessel seams when vessel's access hole is too small to permit interior mechanical alignment.

FIG. 10: special fixture used when cylinder design calls for welds on helix angle, rather than running longitudinally along cylinder axis. This technique reduces hoop stress on welded joint.



STUD welding template *(left)* is used to align welding gun and gage posts, *(below)* 5/8-in. stud gage posts with electro-magnet.



COMPLETED gage and cover is able to record entire strain history of a steel frame member in a building.

English engineer wins 2nd Gregory award

WINNER OF THE 1958 Gregory award "for the year's most outstanding contribution in the field of semiautomatic electric-arc stud welding" is Dr. J. C. Chapman of the Imperial College of Science and Technology in London.

The $1,500 award, the second presented by Gregory Industries Inc., Lorain, Ohio, was presented at the annual awards luncheon of the American Society for Metals in Cleveland.

Chapman's paper described the use of end-welded studs in connection with vibrating wire strain gages to measure stresses in steel building members.

The strain gage works on the principle of free vibration of a taut wire. An electro-magnet "plucks" the wire and then picks up and transfers the data to an oscilloscope. With this information, a known variable frequency can be matched against that of the wire, and the structure strain can be inferred.

In principle, the gage is simple; in practice, the main difficulty is attaching the wire so that structure strain is faithfully transferred to the wire.

There must be no relative movement between wire anchorage and the structure, even when structure strain fluctuates and alternates between tension and compression. (An anchorage movement of one thousandth of an inch, on a 6-in. gage length, would falsely indicate a stress change of more than 2 tons per sq in.)

Advantages gained from use of stud welding are faster assembly, elimination of drilling and tapping and greater gage accuracy.

Gage posts are $\frac{5}{8}$-in. studs, $1\frac{3}{4}$ in. long. A $\frac{1}{8}$-in. slot is milled to accommodate a $\frac{1}{2}$ in. by $\frac{1}{8}$ in. bar to which pressure is applied by an Allen screw. In this way the wire is clamped between the bar and the bottom of the slot.

An external lock nut is provided to prevent spreading of the slot, locking the screw and bar at the same time. Gage posts are correctly aligned with the welding gun, which is aligned with the template by means of tripod studs in holes in the template.

The electromagnet is mounted by $\frac{1}{4}$-in. studs and the cover is fixed by $\frac{1}{2}$-in. studs.

These gages were first used on a building built in England using welded stud shear connectors. The complete strain history of the steel frame members was recorded by the more than 100 gages attached before erection. All gages were operative after completion of the structure.

The paper also suggests many more possible applications for wire strain gages, which were impractical until teamed with stud welding.

TOP: Modified Man-Ten sheet and plate in thickness from ⅜ to 1½ in. is stacked in Hough storage yard to await trimming and forming operations.

ABOVE: Discs for Payloader wheels are flame-cut from ½-in. plate on one of two tracer-head units operated by Hough (⅝-in. plate also is used). Oxypropane is mixture used in cutting discs, which are later submerged-arc welded into wheel rims purchased by Hough from outside vendor.

BELOW: Steel which need not be flame-cut is sheared. Workers here cut ½-in. stock to size for top plate on box-section boom for one Payloader model.

SAY "HUFF"

about Hough

. . . an engineering firm 25 years ago—a multi-million dollar fabricator today . . .

. . . a 10,000-sq ft plant 20 years ago—today, a setup comprising almost 500,000 sq ft . . .

These are unmistakable measures of growth and success, and they were attained by Frank G. Hough Co. The firm, now a subsidiary of International Harvester Co., got its start in 1922 on the basis of development work which culminated in the first hydraulically-operated tractor-shovel attachment.

Initially, the designer of devices operating on this principle, Hough is now the fabricator of tractors and loading attachments produced as integral units.

What lies behind Hough's success? Top-notch and engineering practices, obviously, plus a growing industrial need for its products. And welding, too. Used extensively in fabricating Hough's tractor-shovels and towing tractors, welding gives these vehicles plenty of stamina for everyday operating conditions that can only be described as brutal.

It's rugged...

to handle industry's

How much can it carry, and how fast can it move under full-load conditions? This basically is what the purchaser of a tractor-shovel wants to know.

Frank G. Hough Co. of Libertyville, Ill., feels it has satisfactory answers to both questions—answers incorporated in Hough's *Payloader* line of tractor-shovels.

Produced in several models (with front-wheel or four-wheel drive, or fitted with tracks), these largely-welded vehicles have carrying capacities varying from ½ to 4 cu yd—2,000 to 9,000 lb. (Carrying capacities are determined on the basis of a 4-mph vehicle speed.)

Afield or in a plant. Payloaders can be equipped with buckets to remove earth, sand or gravel . . . with hydraulic grapples to handle lumber or scrap . . . with a rotary plow and loader to clear snow . . . with a blacktop spreader or a street sweeper . . . with a sideboom rig to handle pipe sections.

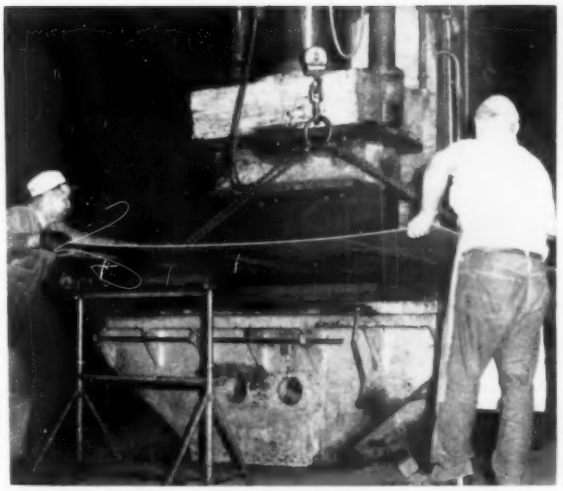
Hough fabricates buckets and some dozer blades in its own plant, and purchases other attachments from Drott Mfg. Corp., Superior Equipment Co., and Ram Equipment Co., Inc.

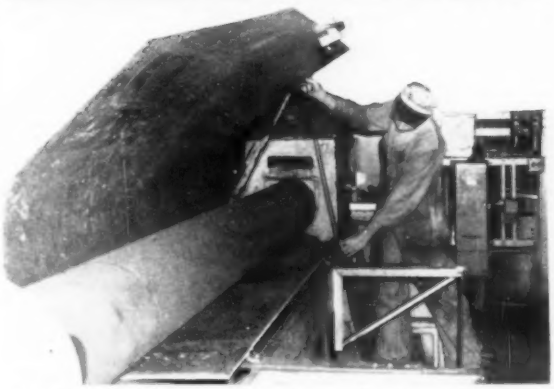
The engine-in-rear design of Payloaders, plus the manner in which front-end attachments are fitted and operated (*see outline sketches*), gives these units definite advantages of balance and stability. And to these features is added that of fast operation which is due, in large measure, to a 4-speed, full-reversing transmission developed and manufactured by Hough.

That welding should be heavily relied on in building Payloaders is a perfectly natural circumstance, at least so far as Hough design and engineering personnel are concerned. Welding more than meets a Payloader's high strength requirements—and coupled with Hough's well-rounded installation of heavy-duty metal-forming machinery, welding makes a stronger product at less cost and at top speed.

Payloaders are fabricated almost exclusively with modified Man-Ten steel—a high-strength alloy with a manganese content greater than regular Man-Ten. (A new experimental tractor is scheduled for fabrication with T-1 steel.)

Steel sheet and plate is received in the Hough yards in thicknesses ranging from $\frac{1}{8}$ to $1\frac{1}{2}$ in. Stacked according to plate size and thickness, the steel is continuously fed from the yard to cutting units in the plant. Sized plate for which there is an immediate need moves further into the plant from the cutting tables. The remainder is moved back to the yard and stockpiled for future use.





TOP: Workers guide ¼-in. sheet slug on chain hoist into 250-ton hydraulic press to form break. Sheet will be used for Payloader bucket.

ABOVE: Break is evident in upper portion of sheet which is now being roll formed. Bucket contour will be obtained in two passes on this unit, largest of several operated by Hough. Note that corners of sheet have been sheared by unit pictured on preceding page.

. . . it's welded

toughest tasks

(Now operating at capacity, Hough is keeping its yard supplies low. But at any time, a company spokesman said, cut steel seldom spends more than four weeks in the yard—not long enough for a serious rust problem to develop.)

For flame-cutting shapes, Hough employs two 8-torch setups and two 4-torch machines, in addition to six stations where manual (one-torch) cutting is done. The multi-torch units are used for the repetitive cutting of circles or other relatively intricate shapes that mechan-

OUTLINE sketch above indicates Payloader's 40-deg bucket tip-back and break-out action at ground level. Load forces for digging are transferred to ground since break-out pads are fulcrum, rather than front wheels. Sketch below shows manner in which vehicle gains stability: load is carried close to machine during travel, and bucket tip-back plus engine-in-rear design give good balance when load clears ground.

VERSATILE is the word for Hough's Payloader models which, with attachments pictured above and many others, can handle such diverse jobs as scrap, earth, gravel, lumber or snow removal, street cleaning, asphalt spreading and pipe laying.

ical cutters could not handle. Manual flame-cutting stations receive complex shaping jobs, and also handle short-run items that cannot economically be set up on the large machine.

Propane is used in preference to acetylene for gas cutting. It is piped to work stations from three 6,000-gallon tanks housed outside the main shops. Operating capacity of the cylinders is 15,000 gallons.

The oxygen used for flame-cutting is currently supplied by trailer tanks, but a liquid storage unit is being considered for near-future use. This, of course, would be a plant owned and operated by the supplier which would convert the liquid product into gaseous oxygen.

Sheet or plate which need not be flame-cut is sheared. For this operation, Hough utilizes a unit with a 10-ft blade that can cut stock up to $\frac{1}{2}$ in. thick. It is powered by a 15-hp motor. Also used early in the metal-forming stage of the overall Payloader fabrication picture are press brakes and bending rolls.

One of Hough's two hydraulic press brakes is pictured with this article. This 250-ton unit has a 24-in. stroke, is driven by a 20-hp motor, and has a bed measuring 7 ft 4 in. by 36 in. The second press is rated at 350 tons.

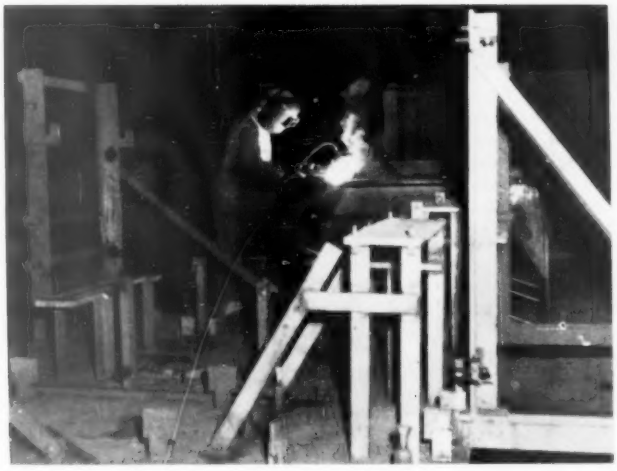
The rolling of parts destined for fabrication as Payloader frame weldments or as major bucket components is carried out on one large, and several small, bending

EXTREME LEFT: Mechanical saw cuts various thicknesses of steel strip which is welded into many Payloader parts to serve as reinforcement.

LEFT: In heavy welding area of Hough plant, this upper boom pivot (one of main frame sub-weldments) is welded with E6014 iron-powder electrodes. Weldor can rotate piece by hand to permit downhand welding.

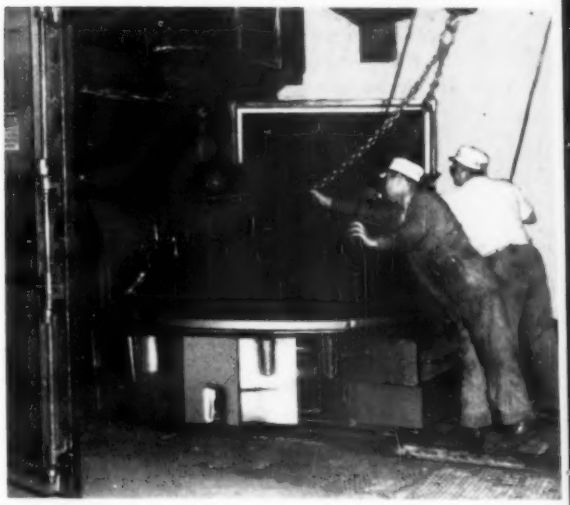
LEFT: Manual metal-arc welding process is applied even to very small payloader parts like this support assembly. Shop-made turntable allows weldor to rotate parts and hold electrode in one position.

RIGHT: Flame-cut wheel discs are welded by submerged-arc unit into rims (note semi-automatic gun adapted for this automatic application). Work is rotated under welding head by positioner. One pass with 3/32-in. wire is laid at 10 ipm; 320-amp current is supplied by m-g unit.



LEFT: Weldor in background is finish welding Payloader main frame that was assembled and tack welded on jig in foreground. For this job, 3/16 and 1/4-in. E7018 electrodes are used at 350 amp a-c.

BELOW: Wheelabrator grit-blasting cabinet is used to clean all weldments prior to painting and assembly. Large enough to hold main frame or several small parts, it is loaded here with two buckets.



rolls. The large roll is capable of handling heavy stock up to 10 ft in width. The rolls on this unit are 11½ in. in diameter and normally form bucket sheets in two passes.

Arc welding operations on Payloader assemblies are carried out in several areas throughout the Hough plant. The manual metal-arc process is the predominant welding method, but the submerged-arc and Mig processes also see continual use. Both argon and carbon dioxide are used as shielding gases for Mig.

Hough uses both a-c and d-c welding power sources. The d-c motor-generator sets are employed when welding thinner gages, and a-c units are used on heavy weldments. A Hough spokesman states that the latter, all of which are 500-amp machines, give weldors better arc stability.

Electrodes used in Payloader fabrication are divided by Hough into two classes. In Class I is the E7018 low-hydrogen, iron-powder type used on joints subject to high stresses and restraint. Class II electrodes include the E6012, 6013, 6014 and 6020 types. Plate thickness being welded dictates which of the four shall be used on a given job.

Steel to be welded receives no edge preparation if it is less than ⅜ in. thick. Edges of all plate ⅜ in. thick or more, however, are beveled 30 deg with a flame-cutter to form 60-deg included angles when plates are butted.

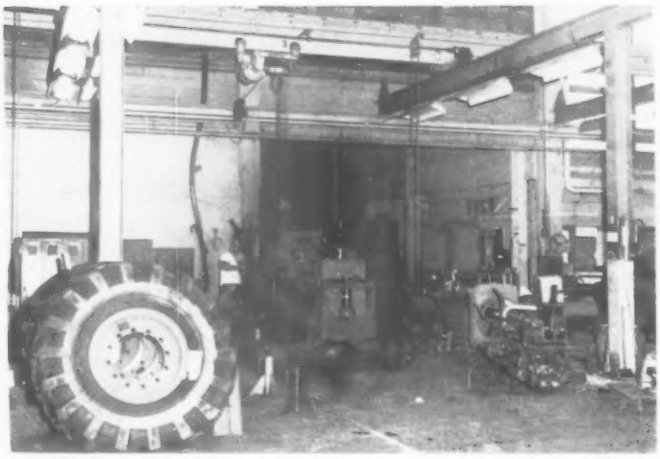
The number of passes required on various Payloader weldments is, of course, a requirement determined by plate thickness. But in one of Hough's larger models, total electrode metal deposited is estimated at approximately 300 lb. This is less than 2% of the unit's total weight of 16,325 lb (with diesel engine).

Some indication of the amount of welding Hough performs on its products may be gained from this run-down of last year's all-plant consumption figures:

E7018 electrodes: 360,000 lb;
E60XX electrodes: 28,500 lb;
submerged-arc welding wire: 9,000 lb;
Mig welding wire: 950 lb;

Payloader components on which all welding has been completed are cleaned for final assembly by shot blasting in a large chamber designed to take several weldments at a time. After shot-blasting, those parts that will be subjected to hard usage are heat-treated.

HOUGH fabricates transmissions it developed for Payloaders. Castings and forgings for transmission are purchased, but are heat treated and machined by Hough. Unit above mills three faces of transmission-case casting simultaneously. Nickel-base electrode is used in welded repair of defective castings.



ONE of several bays where Payloader weldments, motors, wheels and other parts are gathered for final assembly. Though Hough would like assembly-line setup, it has made the most of bay assembly through use of materials handling devices that speed completion of Payloaders and other vehicles produced by firm. Welding is sometimes used in assembly bays on defective parts that are repairable.

Hough personnel developed the system (called "marquench") used for this operation, which employs propane gas-fired furnaces. Object of the heat-treat, of course, is to give parts the highest possible degree of hardness and maximum dimensional stability.

Just prior to final assembly, most parts are prime-coated for protection in the paint-spray shop.

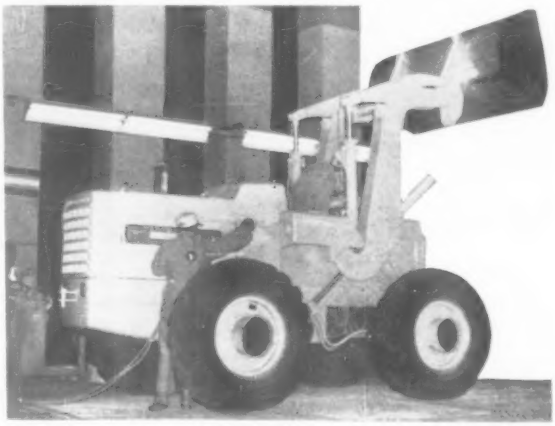
Though it hopes some day to develop assembly-line production of its Payloader and other equipment lines, Frank G. Hough Co. is presently working with the bay-assembly setup for which the plant originally was designed. The bays are well lighted and easily accessible to the shop's numerous material-handling devices: overhead cranes, manually-operated hoists, and small towing and fork-lift vehicles.

Even at this final-assembly stage, welding sometimes plays an important, last-minute role. A maintenance weldor with gas and arc welding equipment is called upon whenever Hough's quality control inspectors spot a part with a defect. If this defect can be remedied by welding in the assembly area, the part is turned over to the weldor; if not, the part is rejected.

Quality control, naturally, is in effect long before sub-assemblies reach the bays. It actually begins as steel moves into the plant for initial cutting and forming operations—and carries through to motor tune-ups and road tests for every finished vehicle.

Control of welding operations to assure quality is largely exercised through the use of continuous visual examinations . . . through magnetic-particle inspection of random weld samples sent out of the plant to a testing firm . . . and through periodic equipment checks.

This emphasis on product quality is not lost on customers, who have indicated that they rely on a Payloader—not only for high load-carrying ability and remarkable speed—but also for the rugged strength built into it by modern welding and metal-forming techniques.



FOLLOWING final assembly, Payloader is painted. Every machine is given a motor tune-up and is subjected to actual or simulated road testing before receiving final approval by Hough's quality control personnel.

TWO examples of extremes in Payloader model sizes are readied for shipment. Small vehicle at left is destined for export, a phase of Hough's business that grows in importance each year. Payloaders and other vehicles in the firm's line are now used in most areas of the world.

Fixture made to order

By Clement F. Brown

OBVIOUSLY, THE MOST economical way to handle complicated welding operations is on a welding positioner. Unfortunately, however, some jobs are so intricate that a standard positioner cannot handle them.

In such cases—or when welding small quantities or special work—tailor-made positioners can be designed. Such a positioner was recently fabricated to accommodate a toothed-shaft weldment.

Body of the shaft (C-1020 forged steel) is 10 in. in diameter and 10 ft 6 in. long. This is machine-finished, but ends are rough-machined to 6⅞ in. in diameter.

Cast-Steel Hammers

To the body are welded twelve 3½-in.-thick, cast-steel hammers. A 1½-in. J-groove is machined on all four sides of the butting edge of each hammer. Deposited weld metal fills these grooves, then ¼-in. fillet welds finish the job. Total weight of shaft and hammers is 2,875 lb.

Because the shaft is part of a breaker unit, and because the rotating hammer must interlock closely with stationary teeth (anvils) on the breaker body, spacing and alignment of hammers become a matter of paramount importance.

Any distortion during welding would upset delicate calculations, so precision is mandatory when fitting-up.

A special positioning fixture was fabricated from a piece of 8-in. schedule 40 pipe, 12 ft long. Welded to one end of the pipe is a stationary angle plate; to the other end a removable angle plate is bolted.

Wooden Bearings

Both plates are slightly larger than the shaft and—as protection for surface areas—2-in.-thick timber "bearings" with 7-in. diameter openings are bolted to the angle plate faces.

Bearings and shaft are coated heavily with grease, rough-machined ends serving as journals.

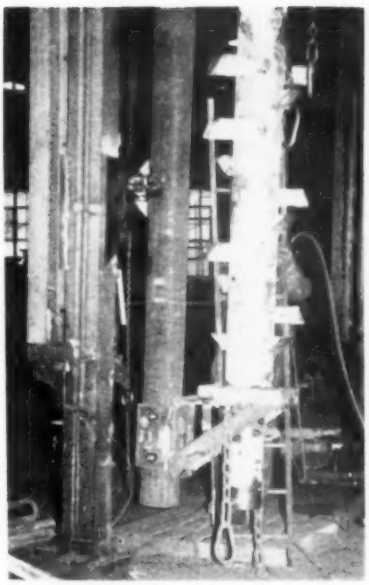
Fixture and shaft are then fastened to a column in the shop by means of a pair of bearing plates welded to the column and by a pivot piece of 5-in. schedule 80 pipe welded to the fixture body.

Pivot center was determined by balancing the entire assembly and locating the lateral center of gravity.

Welding follows an established procedure. First, a stringer pass is made on all hammers with a 5/32-in. E7016 low-hydrogen electrode. (This electrode is used throughout, gradually increasing in size to 3/16-in. and ¼-in. diameters.)

Vertical Positioning

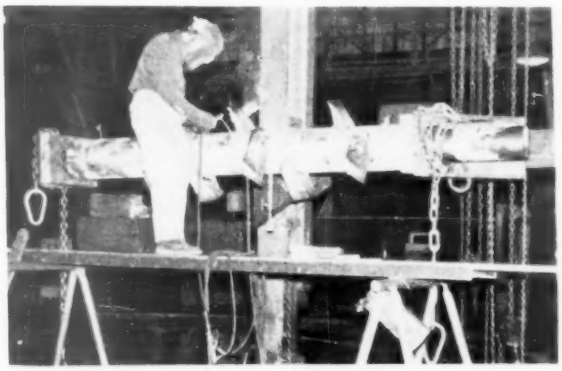
Groove welding begins on one side of the hammers with the shaft in a vertical position. Weldors move from hammer to hammer checking alignment with a combination square, and stopping work as soon as distortion is noted.



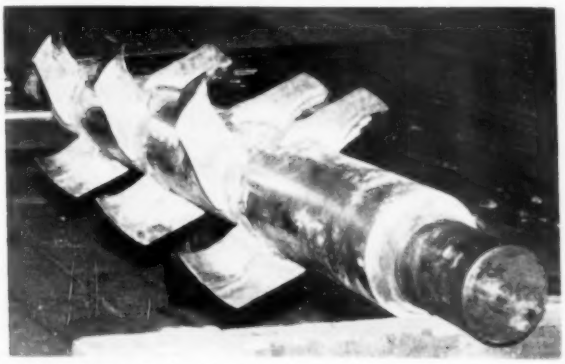
VIEW of vertical positioned toothed-shaft. Note pivot piece.

At this point, the positioner is turned 180 deg and the operation repeated on the other side of the hammers. Side welding progresses in this manner with hammer welds being made while the shaft is positioned as shown in the accompanying illustration.

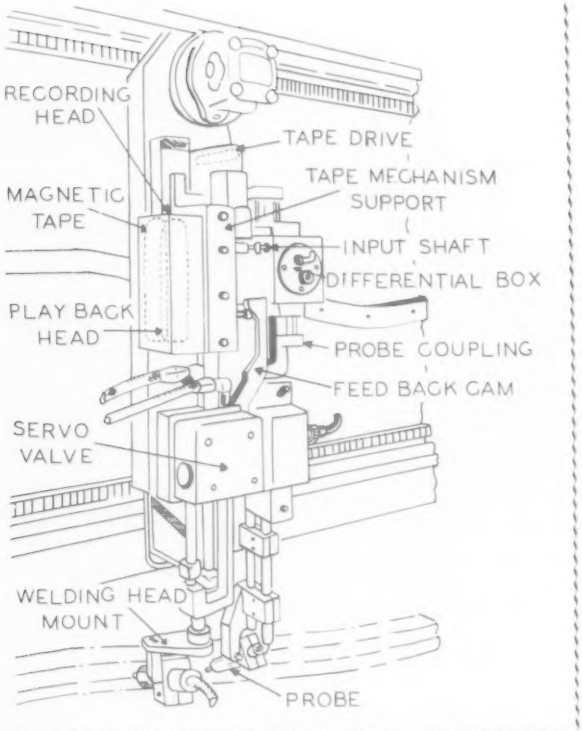
That this style of positioning and welding holds distortion to a minimum is underlined by the fact that dimensional variation between hammers is a maximum 1/16 in. However, average variation is 1/32 in.—and some hammers show no measurable perpendicular movement.



WELDOR joining hammers to shaft. Hammers must interlock closely with teeth on breaker body.



FINISHED shaft showing fillet welds. Welding distortion was held to minimum by shop-fashioned fixture.



—Untrimmed

—Out-of-tolerance

—Straight or contour

Through automation, parts like these can be accurately joined when . . .

Contour welding with a magnetic-tape tracer system

FROM THE WELDING line to the welding machine itself, automation is becoming the watchword of the welding industry—and the automobile manufacturer is reaping a good amount of the benefits.

One such machine, using a magnetic-tape tracer system to fabricate automotive frame side-rails and crossmembers, has recently been introduced by Expert Welding Machine Co. of Detroit. This newest contribution to automation will take its place with the L-shaped welding line for automobile floor pans unveiled earlier this year by the same company. (See: *Automated welding line produces 500 units per hour*, WELDING ENGINEER, June, p. 49.)

Expert's new machine permits joining of metal parts having untrimmed, out-of-tolerance, straight or contour weld line edges in one continuous operation. The system controls self-powered welding heads which automatically and accurately follow any type welding contour.

In general, the basic welding head carriage follows the proposed design contour while a mechanical probe (mounted through a slide on the welding head carriage) follows the actual weld contour line.

Slide movements are transmitted into a differential whose output represents the error between the actual and design weld line. This displacement error is then temporarily recorded on a loop of magnetic tape.

A reading head, located on the same tape loop a few inches behind the recording head, picks up this error intelligence and feeds it through a simple amplifier and hydraulic valve to a hydraulic servo cylinder. The latter then corrects head position for reported errors up to $\frac{1}{4}$ in. of print dimensions, while welding at a rate of 156 ipm.

The distance between the probe (which is positioned a few inches ahead of the welding head to protect it from weld splatter) and the welding head is equivalent in time units to the distance between the recording and reading heads (from $\frac{1}{2}$ to one second).

The magnetic tape is looped to eliminate rewinding and an erasing head clears the tape after the signal has been used. In this way, tapes can be used many thousands of times before replacement is required.

To date, these machines have been using CO_2 Mig welding. However, the basic tracer system is adaptable to any other arc welding process, *e.g.*, submerged-arc or Mig with other gases.

In particular, the machine—as adapted for joining frame side-rails—is a four-post welder with a fixed upper crown straddling a work-holding platen. The entire mechanism and basic contour cams (for driving and partially guiding the welding heads) are mounted on the upper crown. All six welding heads—three on each side of the part—are supported by identical carriages and driven by separate rack-and-pinion motors.

Each carriage-supported welding head is guided by cam rollers in the horizontal direction and partially guided in the vertical. A welding head is mounted to its respective carriage through a vertical slide which permits it to follow the welding line in a vertical plane.

However, vertical contours often deviate from print dimensions as much as ± 3/16 in. and are also non-consistent from part to part. The welding head will not follow the vertical welding line, so the tape tracer system compensates for deviation and correctly positions the machine's welding head.

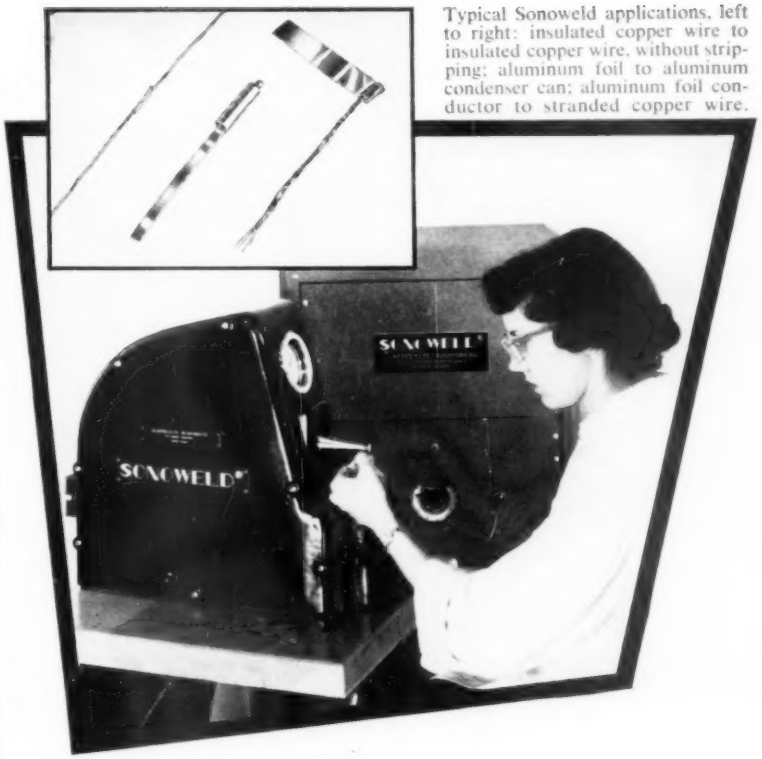
To begin side-rail welding operations, two 12-ft.-long channel halves are first manually loaded into an assembly station at the foot of the machine. Here the two halves are press-assembled with power air clamps.

The assembly is then automatically transferred to the welding station and, after welding, on to an unload station by means of a hydraulically operated walking-beam transfer mechanism.

The welding heads follow the contour of the side rails by means of basic part contour cams. The magnetic-tape tracer system and contour cams together will produce a complete and accurate welded automotive frame side-rail. Using three welding heads on each side decreases weld time and provides maximum production operation.

Operation and design of the crossmember welding machine is essentially the same as the side-rail welding machine. One exception is that the former only uses four welding heads, since the crossmember is shorter than the side rails.

Automated welding—regardless of the process—is the key to faster, cheaper and more efficient production, as the machine above illustrates so well.



Typical Sonoweld applications, left to right: insulated copper wire to insulated copper wire, without stripping; aluminum foil to aluminum condenser can; aluminum foil conductor to stranded copper wire.

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From a plausible theory

on its early beginnings, through

two-horned creations, "broilers,"

stocking hats and derbies,

the author offers . . .

A short history of the safety hat

by **O. W. Trag**

UNEASY IS THE HEAD that wears a crown . . . but easy is the head that wears a safety hat. Thus is the old proverb brought up-to-date for the modern shop worker.

No other invention has saved more lives and reduced man-hours lost because of accidental and unexpected head injuries.

First use of the safety hat is lost in the obscurity of pre-recorded history. But one historian, his name long since forgotten, does have a fairly plausible theory.

When the early descendants of the apes began to walk upright, the remaining (non-evolutionized) tree dwellers bombarded these brash nonconformists with coconuts. This resentment toward "up-rightness" led to many a sore cranium, and something had to be done.

One fellow named Ogg, a chap given to spending his days in the shade of a palm tree, became a special target for his arboreal ancestors. He attained so many lumps and bumps, it was difficult to distinguish between them and his head.

One day while Ogg made his way to his favorite shade tree, he noticed a turtle being bombarded by the apes. The shell-back was being used for some preliminary target practice, and many bulls-eyes were scored. But after the barrage, the turtle went calmly on his way without a scratch.

Ogg's battered brain went into motion. He grabbed the turtle, took off the upper shell and clamped it on his head. Thus did necessity mother the safety hat.

Ancient man developed protective head covering of some kind or other, but the first general use of "hard hats" was in battle. Although the primary purpose of battle helmets was to save lives and reduce casualties, distinctive and imaginative shapes and designs soon came into being. These ranged from the two-horned creation of the Celts to the 14 lb "broiler" used by 12th century knights.

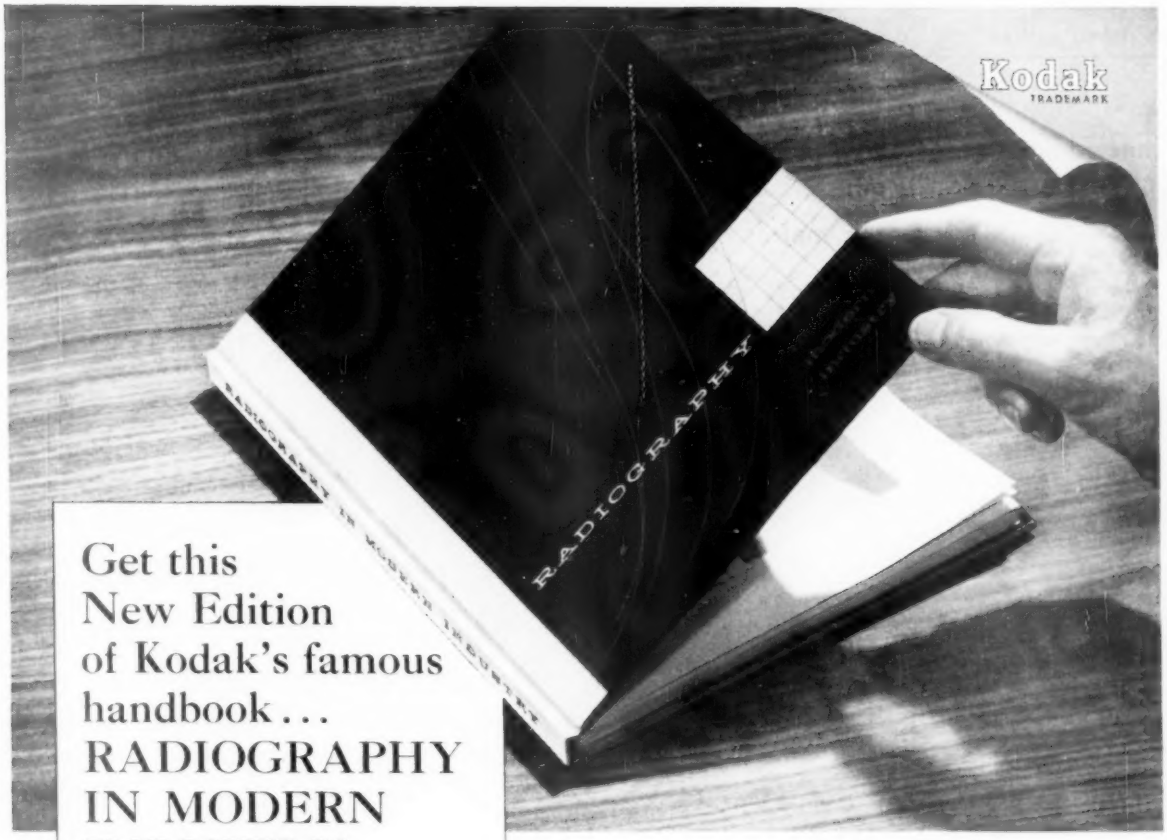
First industrial application of the safety hat occurred during the construction of the obelisk in St. Peter's Square in Rome 400 years ago. The foreman, Domenico Fontana, ordered all workmen to wear battle helmets as protection against falling stones and other objects.

In the 18th century, firemen adopted the helmet, which was often outlandish and cost as much as $500. Early oilmen saved themselves some money by letting their hair grow and wearing stocking hats. And during the same period, structural iron workers stuffed paper in their derby hats, which came to be known as "iron hats."

Necessary as the safety hat may be, the main difficulty has always been to get the worker to wear it. Women workers in one paper mill even went on strike because the safety helmet was "unbecoming." Moslems working on Mideast oil rigs refused to wear them because the brim came between their eyes and Allah.

Today's safety hat, made of fiber and cloth with several coatings of asphalt, is strong, light, cool and comfortable. There is a safety hat for every dangerous job, and statistical files are full of cases where these hats have saved lives.

When the job demands it . . . wear your safety hat!



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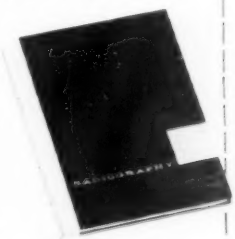

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Concluding a series begun in WE's October issue: electrode material standards—plus tips on weldability of various metals.

Resistance welds will improve if you know your metals and electrodes

by **Lester F. Spencer** . . . *Metallurgical Engineer*

ALTHOUGH HIGH electrical conductivity is often a desirable property of resistance welding electrodes, it is frequently less important than operational economy. This latter factor can be gaged by the length of service obtained between tip dressings.

The truth is that wear resistance and conductivity are almost equally important factors—and perhaps the former is actually more important than the latter. In many instances, the choice of electrode materials must be a compromise between these two important properties.

Most good manuals on the subject recommend that the best electrode material is the one which has the least conductivity consistent with the production of good welds on any given application. By choosing such materials, the user makes the most of the electrode's wear-resistant characteristics and obtains the longest possible service life from it.

But he must be careful—for there is a danger of sticking or alloying between electrode and workpiece if conductivity is too low.

As an aid in the selection of electrode materials to match job requirements, here are the electrode material standards set forth by the Resistance Welder Manufacturers' Association. Presented first are copper-base Group A alloys.

Class 1 copper-base alloys owe their mechanical properties to cold work and composition; they withstand deformation better than hardened pure copper at higher temperatures.

These alloys have high electrical and thermal conductivity, permitting their use as spot and seam welding electrodes in joining aluminum and magnesium alloys; coated materials, and copper alloys. They are also used for seam welding shafts, for flash and upset welding dies, and for projection welding dies and fixtures.

Class 2 alloys owe their properties to a combination of composition, cold work and heat treatment. They are usually recommended for high-production spot and seam welding of mild, low-alloy and stainless steels; low-conductivity brasses and bronzes; nickel-silver, and high-nickel alloys (including Monel).

They are also suited for projection welding dies, seam welding shafts and bearings, flash and upset welding dies, and for current-carrying members.

Class 3 materials are heat-treated, and may or may not be cold worked. They are usually recommended for projection welding dies, flash and upset welding dies, and for current-carrying shafts and bushings. As castings, they are suited for use as highly-stressed, current-carrying machine members, and for heavy-duty offset electrode holders.

Although they are not ordinarily recommended for spot welding, they can be used to advantage in spot welding stainless steels or other materials with high electrical resistance.

Group B alloys are pressed and sintered mixtures of tungsten and copper. They are normally used wherever extremely high deformation resistance is more important than conductivity. Here are the material types available in this group.

Class 10 tungsten-copper alloys are used as facings and inserts for projection welding electrodes, and for both flash and upset welding dies where high conductivity is desirable and a degree of malleability is necessary.

Class 11 alloys are recommended as facings and inserts for flash and upset welding dies, and for general-purpose projection welding electrodes. These materials may be used to advantage in welding steels with high electrical resistance (*e. g.*: the corrosion- and heat-resisting stainless alloys).

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Class 12 electrodes are generally used for heavy-duty projection welding.

Class 13 materials are used in welding nonferrous materials. A good example of their use is in the cross-wire welding of copper and brass wire braid to brass and bronze terminals.

This listing of electrode materials for resistance welding completes the discussion of equipment begun in Part I of this article in the October issue (p. 44). The second important variable which must be understood in order to consistently obtain high-strength joints is the material to be welded.

Various materials respond differently when submitted to a specific welding method. This difference in response is dependent upon the inherent characteristics of a metal or alloy type, and will arise even among metals within a distinct classification.

A metal may be successfully spot or seam welded, for example, but it will not respond favorably to projection welding. Other alloys may be flash-butt welded, but cannot be welded satisfactorily by any other resistance process.

To help you understand the link between metallurgical characteristics and weldability, here are the important facts concerning materials which must often be welded.

Carbon and low-alloy steels. Low-carbon steels, with a carbon content up to 0.25%, are readily spot welded. Steels with a carbon content greater than this can be welded if accessory controls are used.

Postheat, for example, must be used when welding steels with 0.25 to 0.45% carbon content. Postheat does not prevent the increase of hardness; rather, it reheats the hard nugget to a point where hardness is reduced, and this condition can be retained since cooling from the postheat level is less rapid than it was from the weld level.

Carbon content and cooling rate are factors upon which hardness levels are determined.

Higher carbon steels may be flash- and upset-butt welded, but pre- and postheat controls are required to minimize cracking. The low-alloy steels that are resistance welded also will exhibit brittleness in the weld zone due to the hardenability imparted to them by various alloying additions. So precautions similar to those given for higher carbon steels should be observed.

Coated metals. Due to the fact that coating thicknesses and contact resistance of such metals as commercial tin plate, terne plate and galvanized steel will vary widely, welding procedures to handle them must be flexible. These materials, however, are readily spot and seam welded if current and pressure values are properly adjusted.

Since the prime objective of a coating is protection of underlying base metal, care must be taken so that the coating is not completely removed in the weld area. A desirable combination to aid its retention includes higher welding current, higher pressure and a shorter weld time than that employed for a similar thickness of plain carbon steel. These elements will give a weld nugget of desired size without excessive coating disturbance.

The combination of high pressure and good electrode contact protects the spot surface and minimizes the alloying tendency of tip material. Both alloying and pick-up, however, may be difficult to prevent around the periphery of the electrode tip; this is especially true with such low-melting-point coatings as lead, tin and zinc. Recommended preventive measures include: *(1)* short welding times, *(2)* good tip maintenance, and *(3)* attention to electrode cooling.

Tin and terne plate welding recommendations call for a current value higher than that used for a similar thickness of steel. Although coating on the inside surfaces will fuse, the exposed coating may not be seriously damaged. Clean, bright coated surfaces are obtained with:

(a) controlled current and timing;

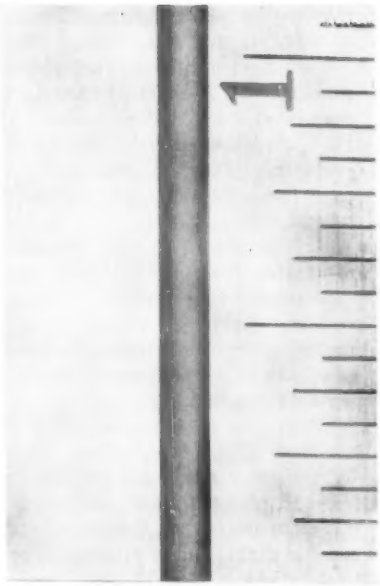
(b) the use of flat-tipped or dome-faced electrodes to minimize indentation, and

(c) the use of full electrode pressure until stock has cooled below the

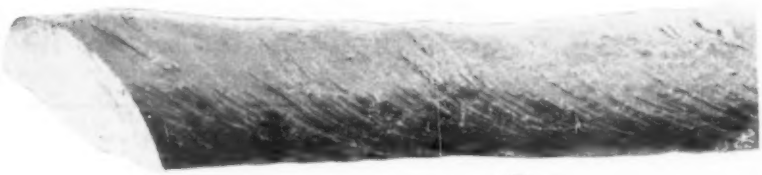
Weldability of various metal combinations

	Aluminum	Stainless	Brass	Copper	Galvanized iron	Steel	Lead	Monel	Nickel	Nichrome	Tin plate	Zinc	Phosphor bronze	Nickel silver	Terne plate
Aluminum	B	E	D	E	C	D	E	D	D	D	C	C	C	F	C
Stainless	F	A	E	E	B	A	F	C	C	C	B	F	D	D	B
Brass	D	E	C	D	D	D	F	C	C	C	D	E	C	C	D
Copper	E	E	D	F	E	E	E	D	D	D	E	F	C	C	E
Galvanized iron	C	B	D	E	B	B	D	C	C	C	B	C	D	E	B
Steel	D	A	D	E	B	A	E	C	C	C	B	F	C	D	A
Lead	E	F	F	E	D	E	C	E	E	E	F	C	E	E	D
Monel	D	C	C	D	C	C	E	A	B	B	C	F	C	B	C
Nickel	D	C	C	D	C	C	E	B	A	B	C	F	C	B	C
Nichrome	D	C	C	D	C	C	E	B	B	A	C	F	D	B	C
Tin plate	C	B	D	E	B	B	F	C	C	C	C	C	D	D	C
Zinc	C	F	E	E	C	F	C	F	F	F	C	C	D	F	C
Phosphor bronze	C	D	C	C	D	C	E	C	C	D	D	D	B	B	D
Nickel silver	F	D	C	C	E	D	E	B	B	B	D	F	B	A	D
Terne plate	C	B	D	E	B	A	D	C	C	C	C	C	C	D	B

Code:
A - Excellent; B - Good; C - Fair; D - Poor; E - Very Poor; F - Impractical



Measure the build-up height...



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coating's melting point.

Similar precautions also are necessary for zinc-coated materials. Satisfactory welds can be made on this material in thicknesses up to 0.078 in. When welding thicker pieces, however, it is difficult to prevent partial destruction of the zinc coating, particularly in the area immediately surrounding the tip. To minimize this effect, a 25 to 50% increase in both pressure and current is recommended.

Aluminized coatings on steel are not affected to any great extent by spot or seam welding. The major difficulties in welding this material arise from porosity and severe indentation.

Those who weld steel with an aluminized coating should use a domed tip with a 2-in. radius . . . should wire brush the surface prior to welding . . . and should increase current 30 to 50% over that used for a similar thickness of plain carbon steel. Maximum time and pressure settings are additional important factors.

Plated metals in general, because of the relative thinness of the protective coating, can be joined with welding procedures similar to those designed for the base metal in question. But because coatings are intended to be decorative as well as protective, resistance welding usually is not recommended for use on them.

Stainless steels. Due to the high electrical resistance of these steels, they are frequently resistance welded without difficulty. When spot, seam or projection welded, however, they do require lower current and higher pressures than would be used to weld mild steel.

Chromium-nickel austenitic alloys are subject to carbide precipitation, which necessitates a short interval of welding time. Synchronous timing control is recommended to insure a proper interval.

There is no particular difficulty in welding ferritic stainless steel, but due to the hardenability of martensitic stainless, both pre- and postheat are required.

Nickel and high-nickel alloys. Nickel and its alloys can easily be welded by all resistance welding methods so long as precise, synchronous welding controls are used.

For *projection* welding, high pressures and long weld times are advisable.

For *flash* and *upset butt* welding, the higher hot strength and greater electrical resistance of these alloys necessitates higher forging pressures and less initial jaw spacings.

Copper alloys. Welding copper by the spot, seam and projection methods is difficult, but flash-butt welding will give satisfactory results since heat is localized at abutting edges.

Thin-gage material, less than 0.035 in. thick, may be spot welded if high-conductivity electrodes faced with tungsten or molybdenum are used. Due to copper's high electrical conductivity, current requirements may be six or seven times greater than those required for mild steel and pressures are approximately 50% higher.

Save this article—

—and the one which appeared on pp 44-47 in the October issue of Welding Engineer. *They form the basis for additional articles by L. F. Spencer on spot, seam, projection and flash-butt welding to be published in the near future.*

Weldability of copper-base alloys depends upon electrical conductivity and resistivity of the specific alloy; as copper content within the alloy decreases, so does weldability. (Whatever the alloy, however, projection welding usually is not recommended, since the projection will collapse under pressure.)

Muntz metal. Tobin bronze, Naval brass and manganese brass are relatively easy to weld in thin gages if high currents, a short welding time and pressure greater than 400 psi are used. Red brass, low brass and commercial bronze have slightly better weldability than copper. Due to their relatively high copper content, however, requirements for welding them are similar to those used for copper (*i. e.*: low electrode pressure and fairly high energy input). Low joint strength and electrode sticking are the problems encountered in welding these alloys.

Yellow brass, commercial brass and Admiralty brass can be spot and seam welded, but the procedures must include sensitive variations of current, pressure and timing.

Phosphor bronzes are weldable if welding time is short. Required energy input is low, but electrode sticking and pick-up probably will be encountered. Phosphor-bronze welds have good strength, but may have poor ductility.

Due to their higher electrical resistance, both nickel-silver and cupro-nickel alloys require less current and higher pressures. One difficulty experienced with the latter is a tenacious refractory oxide that must be removed.

Silicon-bronze alloys are rated as the best of the copper-base alloys for resistance welding. They require low energy input, short timing and moderate pressures; there, is, however, a slight tendency toward electrode sticking.

Aluminum alloys. These alloys are extensively spot, seam and flash-butt welded, but projection welding usually is not recommended since the projection will collapse. The high electrical conductivity of aluminum alloys necessitates the use of high-capacity welders giving precise control of energy input, timing and rapid follow-up.

High-tensile alloys 2017, 2024 and 7075 are considered the most weldable, since they exhibit less tendency toward sheet separation and show better and more consistent weld strength. Spot welds in these alloys, however, may be selectively attacked under severe corrosive conditions. Partial protection is obtained if one sheet is clad with pure aluminum. But this cladding will eventually corrode, and full protection is obtained only when both sheets are clad.

Such low-tensile alloys as 1100 and 3003 have greater freedom from cracks and porosity, but exhibit greater surface indentation and sheet separation with inconsistent weld strengths.

Alclad alloys are more difficult to spot weld than bare alloys due to their low resistance, and to the high-melting-point surface at the contacting interfaces which decreases weld strength consistency.

The chromium-bearing alloys 5052 and 6053 exhibit porous welds—particularly when in the hardened condition.

Magnesium alloys. Those wrought

magnesium alloys that are resistance welded include ASTM AZ31A and M1A in the form of sheets and extrusions up to about 3/16 in. thick. Some spot welding of ASTM AZ61A also is done.

Due to their high electrical and thermal conductivities, relatively low melting point, and sensitive plastic range, magnesium alloys are welded with equipment, weld cycle control and working techniques that are similar to those used on aluminum alloys. Therefore, high current, short weld duration and very rapid electrode follow-up with sufficient pressure is required.

Projection welding of magnesium alloys is not done because of insufficient strength in the projection. Flash welding, although used only to a limited extent, will produce excellent welds. ASTM M1A is not as easily flash welded as the other alloys.

Zinc and lead alloys. Zinc and zinc-base die castings can be satisfactorily welded—but with an attendant loss of strength—by the spot, seam, projection and flash-butt methods. Synchronous timing is required, together with low energy input, low electrode pressures (to reduce indentation and penetration), and longer weld times. Electrode pick-up may prove troublesome in these applications.

Lead's low melting point and unusual softness calls for spot, seam and flash-butt welding techniques similar to those used on the zinc alloys.

"There are still a couple of things about welding that I'm not sure of."

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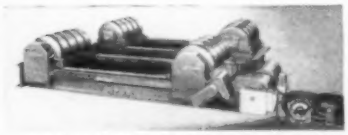

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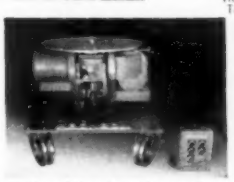

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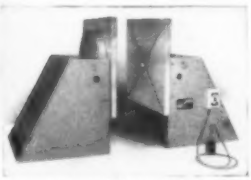

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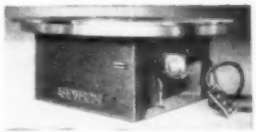

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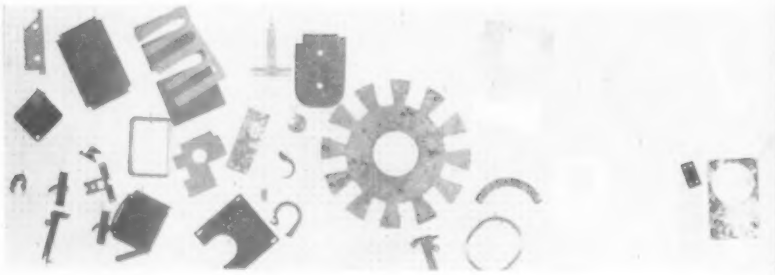
VIEW of some of the stampings made with the new blanking method.



Many industries have contributed to welding's great advances in the past—and today . . .

New metal-blanking process offers labor and cost savings

by **Gregory Cannizzo**

AN ENTIRELY NEW (and patented) idea for economical tooling is taking giant steps in American and foreign industries, *e.g.*, appliance, automotive, aircraft and electronics.

The metal-blanking method, known as Templet Industrial Process (TIP) and under patent rights to Templet Industries Inc. of Brooklyn, is rapidly replacing conventional dies in many areas of industry.

Reason: unheard of savings in die-making costs and labor.

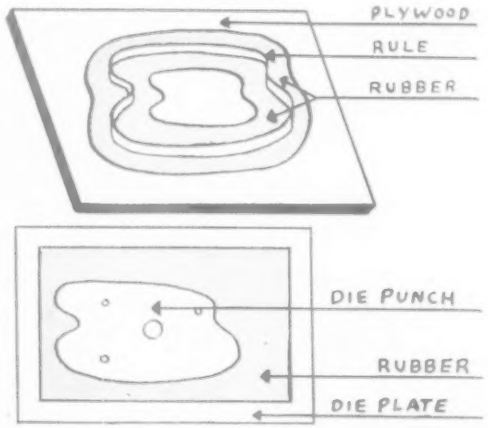
Reportedly, TIP can save as much as 80% of the cost of a conventional die at no sacrifice to production time or die life, and releases the skilled diemaker for more important work. These two advantages hinge on the process's small initial cash outlay and the simplicity of materials needed for the die.

Basic materials required in the fabrication of this new type of die are: $\frac{3}{4}$-in. plywood board, tool steel rules, thin die plates and rubber stripping. From these materials any type of die, simple, compound or progressive, can be made economically and quickly.

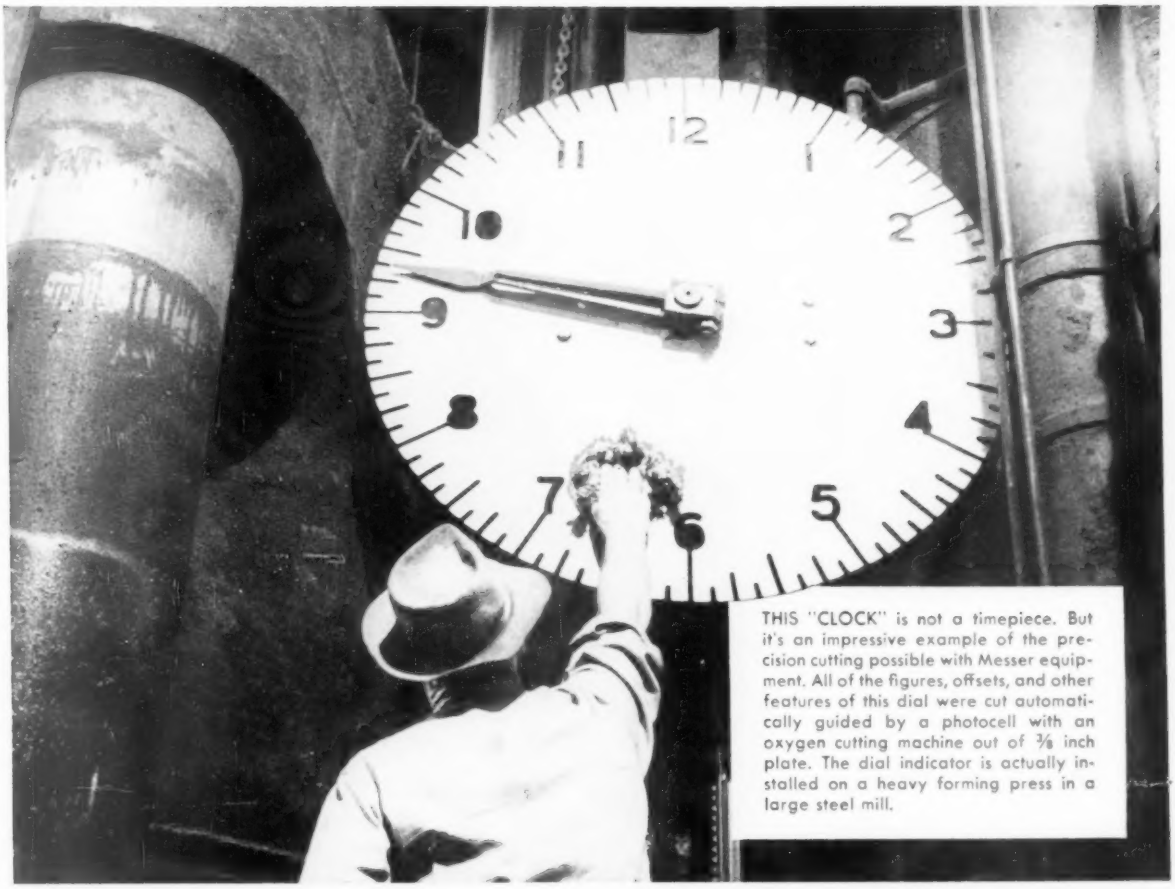
Here is how a typical TIP die is fabricated:

The outline of the part to be blanked is first sketched on the plywood board either from a part print or a master blank. The board is then drilled with access holes for the jig saw, and the entire outline is cut out. (Width of the saw blade is determined by the required thickness of the steel rule.)

The steel rule is chosen, its width



LEFT: Mike McCauley of Presto Stamping Corp. holds TIP die used to blank blower end housing from cold rolled steel. Die cost was $510; production rate, 325 per hour. Above: a typical rule die and punch.



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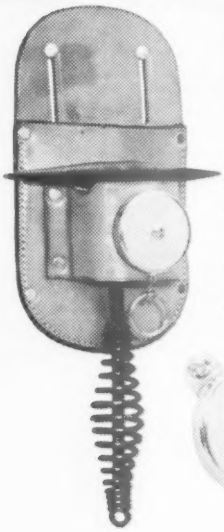

11-W

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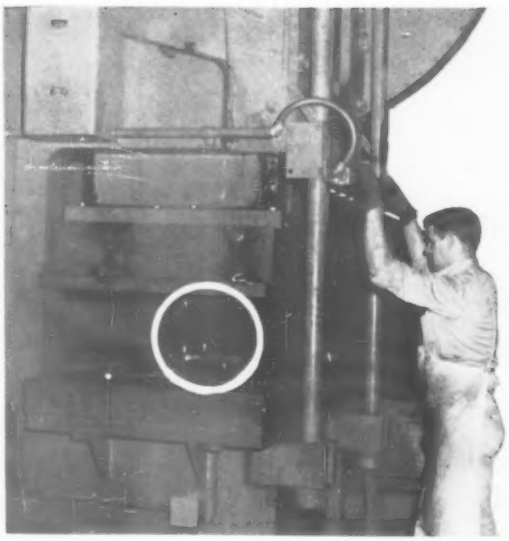

WORKER is ready to actuate punch press. Rule die and punch (circled) have been positioned in the 40 by 60-in. bed area.

and height being determined by thickness of the stock material being blanked. It is then cut and fitted to the contours of the board. Larger rules are required as stock material thickness increases.

(The Templet process is practical on material up to $\frac{1}{2}$ in. thick, but experiments have been run on $1\frac{1}{4}$-in.-thick steel.)

At this point another distinct advantage is evident. Curves and turns previously excluded in conventional dies because of tooling costs, can now be included by the product designer.

Rubber stripping is glued to the die to facilitate shedding or ejection of material—a job which normally entails time-and cost-consuming installation of springs in conventional dies. With grinding of the bevel on the steel rule, the top die is complete.

The punch section of the die also varies in thickness, depending on the stock thickness of the material to be blanked. The die outline is first transferred to the punch, which is then sawed to the defined contour. Holes for piercing punches are drilled, rubber stripping (as mentioned above) is added, and the complete die is ready for production.

Although the equipment itself is basic, tolerances of $\pm$ 0.002 of hole location and $\pm$ 0.005 of shape are possible. Dimensions remain constant and if closer tolerances are required, precision equipment can be used. (One manufacturer is holding tolerances of $\pm$ 0.001 in titanium and stainless steel.) Any metallic and non-metallic material can be stamped with this steel rule die.

The complete tool can be used in standard punch presses, is not limited to size and can be run with or without die sets. (Presto Stamping Corp., Arlington Heights, Ill., a representative of the New York company, maintains 210-ton presses with bed area capacities of 40 by 60 in. for its customers.)

Performance records include: heaviest gage stamped, $\frac{1}{2}$-in., .1010 plate; longest run on one die, 300,000; hardest metal stamped, Rockwell C-47,400 series stainless; largest die made to date, 16 ft. long; thinnest material stamped, 0.0025 stainless.

One final advantage to be considered is that the dies, being light and compact, are easily stored, saving both needed plant space and handling costs.

Since the process is patented, it is available to industry through licensing. (Some licensees: Bastian-Blessing, GM, Harvester, GE, Sperry-Rand, RCA, Bendix Aviation, A. O. Smith, Willys Motors, Hotpoint.)

Licensees are provided know-how and information to methodize their plants for this die-making process in the shortest possible time. Plant technicians are trained to build these steel rule dies from the blueprints normally used in their own plants, and may return for refresher courses during an allotted time period.

TIP may be the tip-off to greater tooling savings in cost and labor.

Riding out the recession

FOR FOUR MONTHS in a row, business grew worse at the Louisville Machinery & Welding Co. The firm's president, R. H. Eggleton, debated his alternatives: lay off employees, close the shop entirely, or . . . design a product that was inexpensive and would *sell*.

Machinery & Welding took the third course.

"Our anti-recession idea," Eggleton says, "was to build the smallest motor scooter we could. One that could be carried in a small airplane or in the trunk of a car without having to fold it, then sell it to people who need to make short trips, say, from a mile and a half to two miles."

—*Courtesy Hobart Bros. Co.*

THIS scooter helped one firm boom when others were going bust.

Weldors, Eggleton figured, need not be dismissed because the Super-Scooter would have an all-welded frame to support the 2½ hp, air-cooled motor that would drive the scooter to a top speed of 30 mph while giving gasoline economy up to 100 miles per gallon. And the scooter *is* small, weighing only 55 lb, yet with welded strength, capable of supporting a 300-lb man. It stands only 22 in. high, is 12 in. wide and 33 in. long.

Has the tiny vehicle helped end this job shop's recession doldrums?

Shortly after the scooter was introduced, orders began arriving from all parts of the country: Wyoming, Florida, Pennsylvania and, of course, many from Kentucky. This influx not only kept four men at work—but seven extra employees had to be hired.

TOP
Producer
TOP
Quality
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HARRISBURG CYLINDERS
Over a hundred years of the finest skill and experience go into every seamless high pressure gas cylinder produced by Harrisburg Steel since it first started manufacturing them in 1902. Harrisburg offers a complete service organization second to none producing cylinders of both light weight chrome molybdenum steel and standard manganese steel. By constantly striving for improvement Harrisburg has earned its present position in the cylinder business as the top producer, top in quality and top in service life.
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HARRISBURG STEEL CO.
Division of HARSCO CORPORATION
TUBES
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A complete line of Welding Equipment . . . Built for better service . . . Priced for better value.

Write for catalog No. 5605 and name of local distributor.

Dockson CORPORATION
3839 Wabash
Detroit 8, Mich.

KEY to De Witt System is special top plate with protractor device. Operator is cutting angles in aluminum tubular member. Equipment was shown to aluminum, steel and welding industries in recent weeks.

Fast joint preparation on tubular members

. . Look for new concept in cutting angles in structural shapes and tubing to be introduced shortly to welding industry.

THUS DID WELDING ENGINEER report several months ago first word of a new device for mechanical cutting, which has now been unveiled. Wallace Supplies Mfg. Co., Chicago, demonstrated the De Witt system (named for E. J. De Witt, head of the firm) to representatives of the aluminum and welding industries on Oct. 15 and to the steel industry on Nov. 13.

Preparation of joints for welded fabrication will be speeded by use of this equipment which utilizes a protractor head that is still considered highly confidential.

The De Witt process is accomplished on a standard cutting machine made by Wallace, with some slight modification. To convert it to joint preparation set-up, only four nuts need be removed and the top plate replaced with a special top plate (the protractor head).

AFTER cutting, and with no further preparation, small diameter tubing is welded by Tig process.

The latter is a table-vise type fixture which can be rotated through a plane at right angles to the path of a cutting wheel, and at the same time be shifted (if needed) horizontally.

This permits the operator to read settings from a copyrighted chart (available with the Wallace machine) so that coordination of settings on the machine and three cutting operations will produce a tube end that requires no more preparation prior to welding.

The cut-off wheel can be either abrasive or metal.

Members of the aluminum industry at the October gathering in the Wallace plant included representatives from Alcoa, Kaiser and Reynolds. Welding manufacturers represented were A. O. Smith, Westinghouse and Hobart.

The consensus of these men regarding the De Witt system:

It promises economy and speed of fabrication of tubular structural members never before possible . . . the groove necessary for welding is a "built-in" feature of the cut . . . many man-hours of filing, milling, grinding and chipping will be eliminated . . . uniformity of a run of weld joints without excessive gaps and with good fit are now possible on non-ferrous structural tubing . . . this joint preparation allows a weldor to obtain full penetration . . . for the first time aluminum has a cutting process that will bring it closer (on a competitive basis) to steel, which has always had flame-cutting.

Low Temperature EUTECTIC WELDING ALLOYS

Plant, Research Laboratory and World Headquarters

HISTORY OF "EUTECTIC LOW TEMPERATURE WELDING ALLOYS"®

Surface alloying at low heat was first discovered by "Eutectic" in 1904 – used today in over 100,000 plants. "Eutectic" is the originator and sole manufacturer of "Eutectic Low Temperature Welding Alloys" for bonding metals at low heat, minimizing distortion, warping and stress.

EUTECTIC Welding News

PUBLISHED BY EUTECTIC WELDING ALLOYS CORPORATION, 40-40 172 STREET, FLUSHING 58, NEW YORK, N. Y.

CAST ALUMINUM GEAR HOUSING REBUILT IN JUST TWO HOURS!

A severe blow cracked this expensive aluminum gear case. The lengthy crack passed through the ribs of the case as well as the flange. Replacement with a new casting meant considerable expense, but the difficulties of welding aluminum satisfactorily seemed to rule out repair, until the local "Eutectic" Technical Representative was called in and recommended Eutectic's EutecTrode 2101 with "Frigid Arc" flux coating.

EutecTrode 2101, makes joints which are up to three times the strength obtained with conventional aluminum welding electrodes. Ultimate tensile strength—34,000 psi. Deposits are smooth, dense, non-porous and spatter-free. Arc is quick and easy to maintain. EutecTrode 2101 is non-fuming, has amazing arc stability with high corrosion resistance, good color match to aluminum.

This particular electrode is widely used for the production and maintenance welding of home appliances, chemical, food processing and refrigeration equipment. It is also used for decorative and protective railings, tanks, structural members, pipe, foundry patterns, truck, automotive and bus structures. Other applications include repairing cracks, filling holes, building up missing sections, cladding and reinforcing.

To prepare the gear case for the filling operation the crack was chamfered through its entire length. There was no porosity, no holes throughout the fill and build-up. To finish the job a sander was used to smooth the surface. The completed gear case had the appearance of a new replacement part.

Only two hours were needed to complete the repair of the cast aluminum gear housing, and return it to operation.

EUTECTRODE 680 AC-DC

inaugurates new auger life

This farm auger was so badly worn it required complete rebuilding. The condition is common in farm tools used in abrasive soil. Because of widely varying soils, blades that give good service in one area can fail completely after a few acres in another. Today, maximum acreage service under all conditions is assured with regular use of EuteChrom overlays.

Best results with hard surfacing are attainable in many cases by first using a padding layer of EutecTrode 680 AC-DC. The padding base offsets any possibility of cracking during the welding operation, and in service, absorbs much of the impact shock. Thus, long life is insured with this hard overlay.

To repair this auger, a new steel strip was welded to the blade rim with patented EutecTrode 680 AC-DC. All wear surfaces were then overlayed with EutecTrode 12 AC-DC. This economical reconstruction gave the auger months more service life than even new equipment could provide.

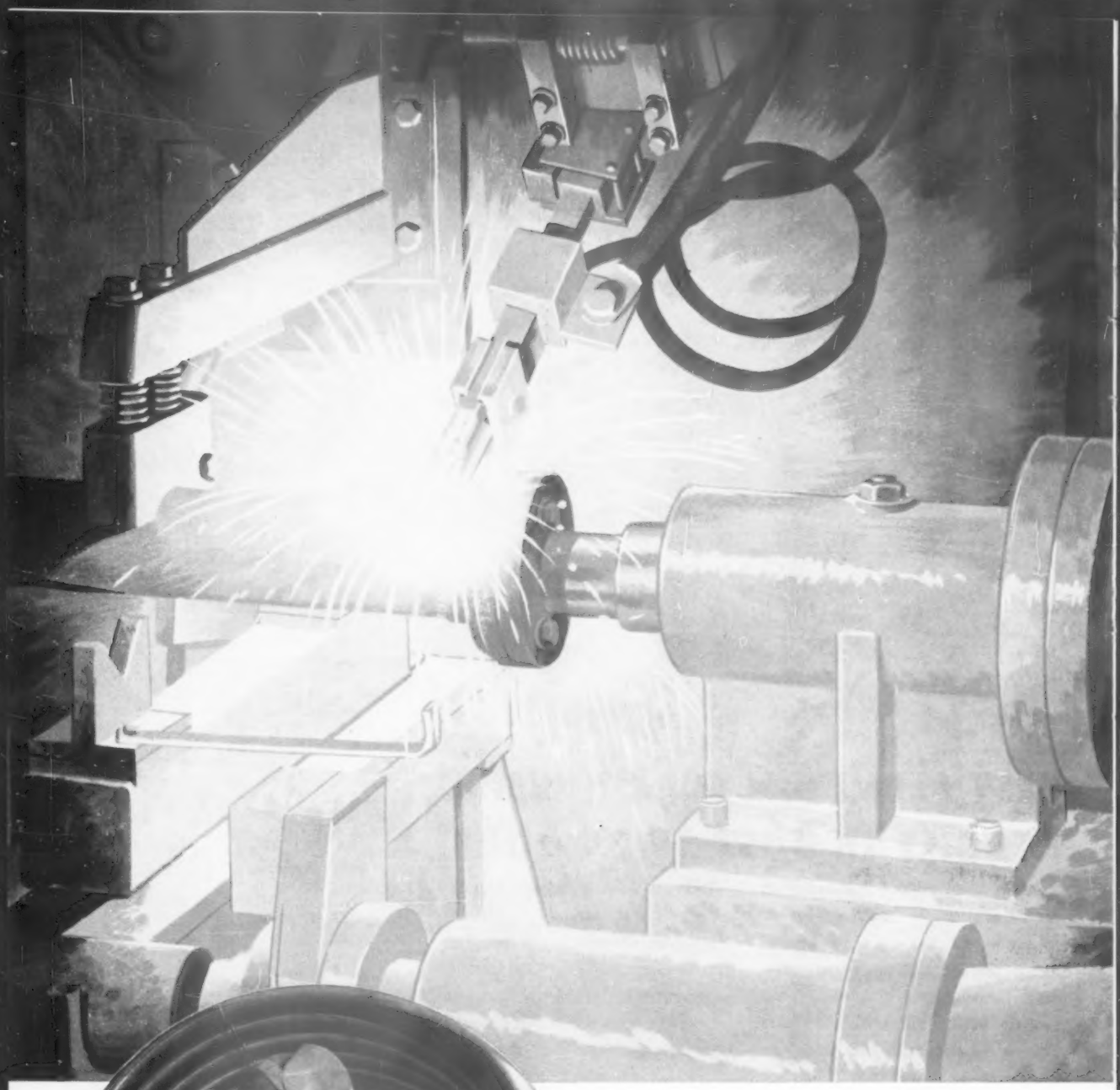
EutecTrode 680 AC-DC, available in 3/32", 1/8", 5/32" & 3/16" dia. Lt. Blue Tip. • **EutecTrode 2101,** available in 1/8", 5/32", 3/16" & 1/4" dia. Orange Tip. Standard weight shipments.

FREE WELDING ADVISORY SERVICE AVAILABLE THROUGH YOUR LOCAL "EUTECTIC" TECHNICAL REPRESENTATIVE

A staff of technical welding experts are ready to consult with you. Write for help on any welding problem.

SEE OUR EXHIBIT AT THE 23RD NATIONAL EXPOSITION OF POWER & MECHANICAL ENGINEERING —COLISEUM, NEW YORK, DEC. 1-5 BOOTH 154.

EUTECTIC 'LOW TEMPERATURE WELDING ALLOYS'® FORMULATED FOR 'LOW HEAT INPUT' BONDING OF ALL METALS INCREASE SAVINGS BY SALVAGE AND REPAIR, SOLVE PRODUCTION PROBLEMS



West-Ing-Arc® Dynamic Reactor greatly enlarges the fields of applications for welding and results in many "plus" benefits at a small investment to the user of any semiautomatic or fully automatic welding process equipment employing constant potential (voltage) power source.

If you presently use West-Ing-Arc equipment, or contemplate its use—the addition of the Dynamic Reactor results in cost-cutting extras . . . in addition to the efficiencies already inherent in the West-Ing-Arc process.

Order this versatile addition to your present equipment *now!* Or write for complete details on how this equipment can result in savings. Address: Dynamic Reactor, Welding Division, Westinghouse Electric Corporation, 4454 Genesee Street, Buffalo 5, New York. J-22140

YOU CAN BE SURE...IF IT'S Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS," CBS TV MONDAYS

A "triple cost-cutting" **EXTRA** for welding mild steels, stainless and aluminum

The NEW WEST-ING-ARC® DYNAMIC REACTOR

FOR USE WITH AUTOMATIC AND SEMIAUTOMATIC GAS SHIELDED, DC WELDING EQUIPMENT UTILIZING CONSTANT POTENTIAL POWER SOURCES

"ALL-POSITION" WELDING!
Overhead—vertical up—and down! Stability of arc at reduced setting.

REDUCED ELECTRODE WIRE COSTS!
Use at least one size larger diameter wire with no change in current setting, voltage or feed speed. Cost reductions from 1¢ to 17¢ per pound of deposited weld metal.

GREATER VERSATILITY!
Light-gauge metals now may be arc welded. No slag removal problems; practically no "spatter" . . . finished products are ready to paint or plate. CO_2 gas shielding for mild steel hand gun welding is practical!

STYLE 565D956G01

STYLE 427C503G01

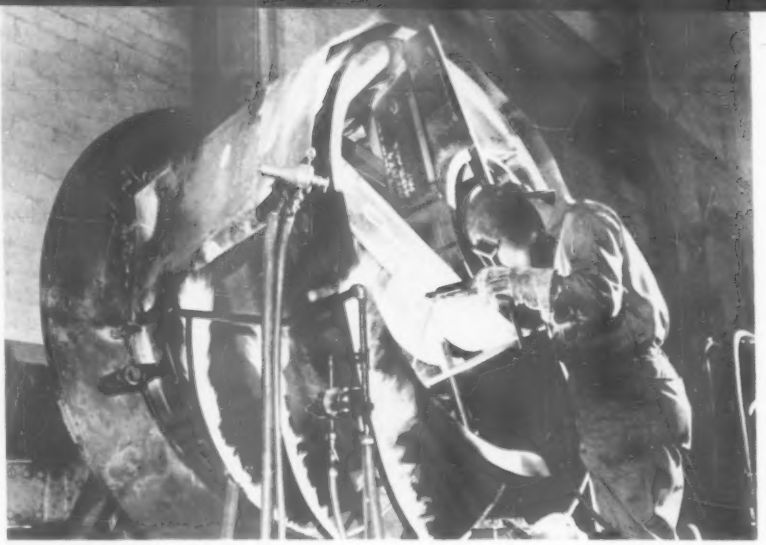
2 LOW-COST, DUAL-RATED MODELS

- Style 427C503G01—150/300 amperes 100% duty cycle—Zone 1 price* **$159**
- Style 565D956G01—300/600 amperes 100% duty cycle—Zone 1 price* **$259**

*Slightly higher in Zones 2 and 3

ORDER NOW!

Watch Westinghouse for New Developments in Welding!

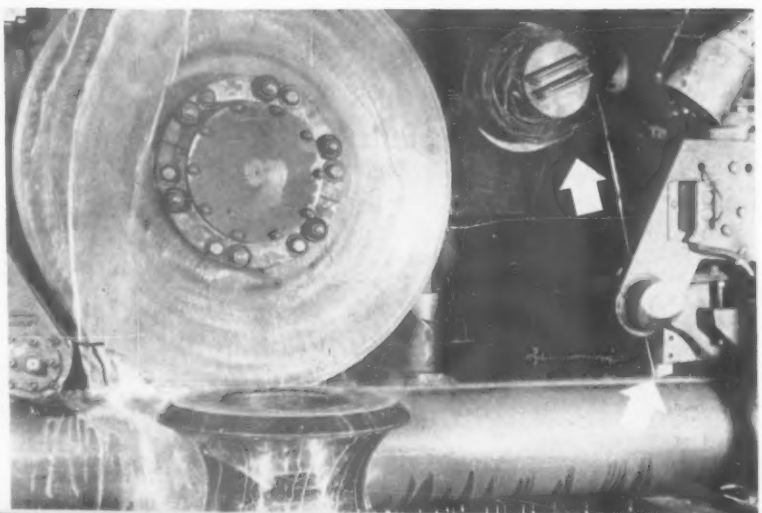


HALOS of flame surround this weldor as he joins a 3-in. thick chrome-moly steel center hub and radial members to a gas turbine cylinder of the same metal. R. C. Mahon Co., Detroit, which tackled the job, mounted each of the 4,850-lb cylinders on a positioner so the operator could weld in a nearly horizontal position. Heating wasn't so easy, however. Heat had to be maintained constantly at 450 F during welding to avoid stress cracks. The firm handled the situation by arranging pipes carrying natural gas and air in a circle about the work, and then igniting the gas mixture. Sheet-metal hoods helped hold the heat as the weldor worked. An E9016 low-hydrogen electrode was used for actual joining. After welding, stress relieving and machining, warpage and shrinkage had been held by this method to within 1/16 in. limits.

On the Job . . .

WHEN ingenuity is applied, positioners can take many forms. This one—used to hold a low-carbon steel axle as it is welded to a 650-lb stainless-steel mixer blade—was conceived by engineers at Baker Perkins, Inc., Saginaw, Mich. It consists of an old lathe chuck and a variable speed drive to both hold and rotate the work. A pedal arrangement allows the weldor to control the unit as he applies the stainless-steel electrode. When the operator has made all welds around the 4-in. diameter axles, the blade will be used to mix solid-liquid rocket and missile fuels. Welding time on the axle: four hours.

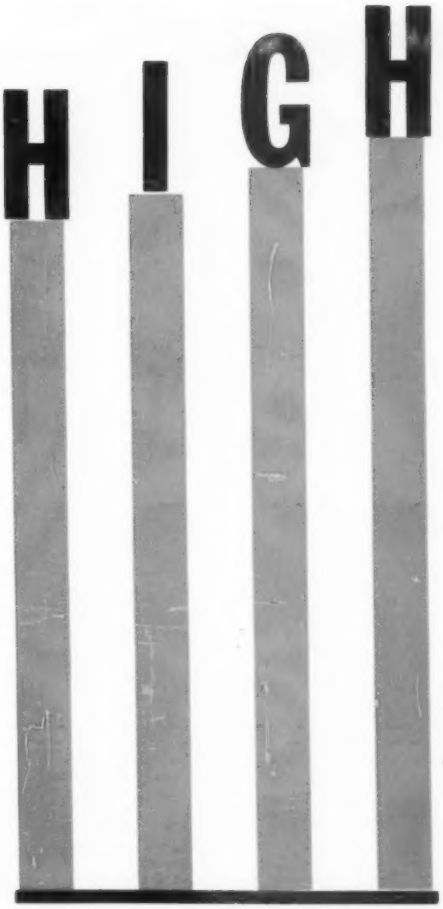
SCARFING pipe welds can be a problem as Beall Pipe & Tank Corp., Portland, Ore., learned. Flash butt welding 40 to 50 ft lengths of continuously welded pipe at about 35 ft per minute created cutting tool troubles. Tools broke frequently and wore rapidly, slowing production. Through consultations with Allegheny Ludlum Steel Corp. engineers, the firm licked the problem. It initiated use of a carbide cutting tool manufactured by Allegheny's Carmet Div., which increased production from 6,000 ft to 10,000 ft per cutting tool and feed rates to 50 or 60 fpm. Also, weld beads are now cut in a continuous ribbon and coiled on a spool (arrows) for efficient handling.



Now . . .

an all-time circulation

for Welding Engineer



Welding Engineer has always stressed quality rather than quantity, and these same standards prevail with the added circulation that now brings our total to more than 25,000.

This new base is an extension of our philosophy of **Circulation Concentration,** for where there is welding, there, too, is **Welding Engineer** . . . 80% of **WE's** circulation is concentrated in the 13 states that account for 79.2% of the welding fabrication in the United States.

Men recently added to the subscription rolls have had to meet the same high standards of qualification set many years ago by **WE.** Readers of **Welding Engineer**—past and present—are the industry's opinion leaders, the buyers, the men who manage.

That's why we like to echo the words of a leading advertiser who recently remarked, **"Are we so utterly lost in computations of cost-per-thousand that we buy circulation at so much per pound like meat? How much of what we pay for advertising is for U. S. Prime, and how much is for fat, gristle and bone? Where are the concepts of depth and significance and advertising effectiveness?"**

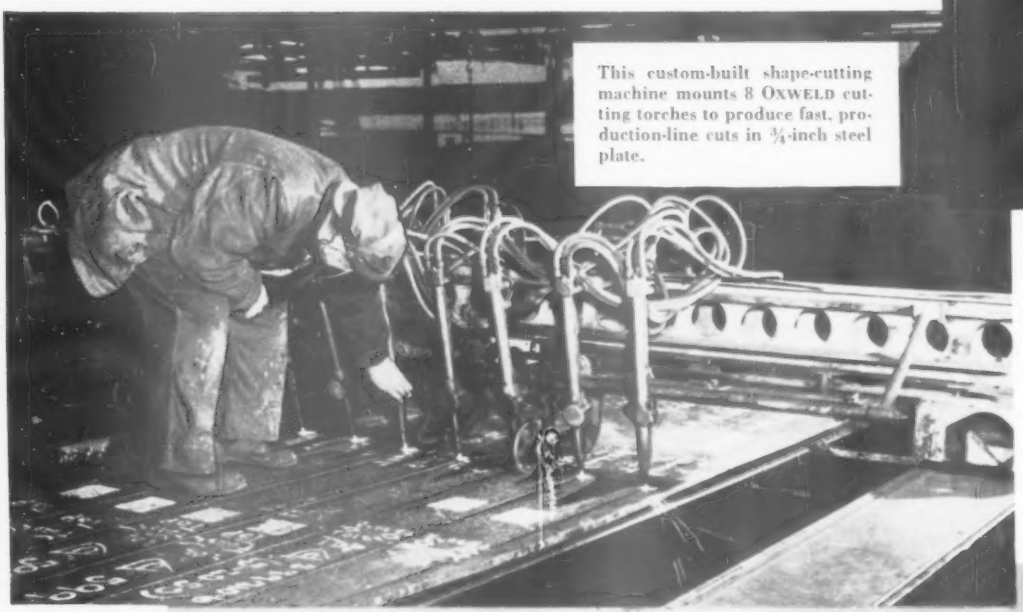
Our district managers will be happy to explain the manner in which **WE** will further saturate the welding market. They will provide you with details that will enable your advertising dollar to obtain the maximum potential from the welding market.

Write, wire or phone:

WELDING ENGINEER • Morton Grove, Ill. • ORchard 4-5130

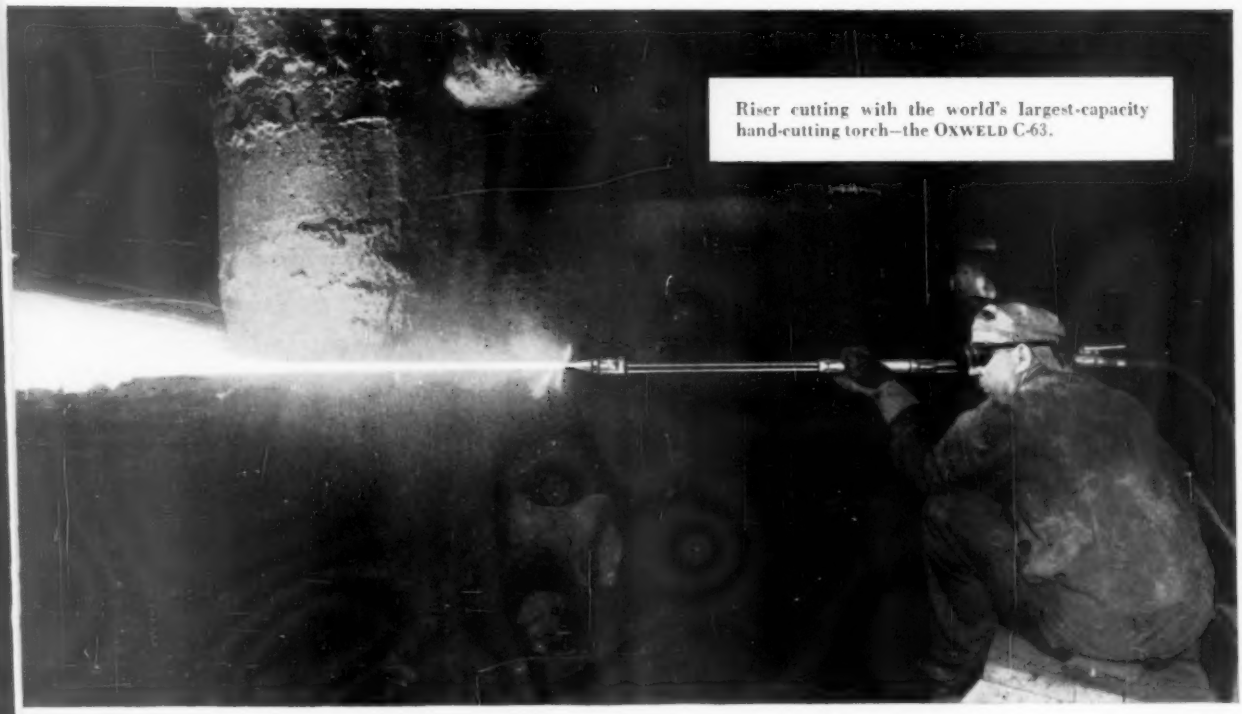
Editorial Leadership means Advertising Readership

NOW Oxweld TRADE-MARK CUTTING TORCHES...



This custom-built shape-cutting machine mounts 8 OXWELD cutting torches to produce fast, production-line cuts in ¾-inch steel plate.

A full selection of precision-made OXWELD nozzles assures maximum usefulness for every cutting torch.



Riser cutting with the world's largest-capacity hand-cutting torch—the OXWELD C-63.

...for every fuel gas combination

★ OXY-ACETYLENE ★ OXY-PROPANE
★ OXY-NATURAL GAS

Hand-cutting, shape-cutting, scarfing, powder-cutting . . . you name the cutting job! And pick the fuel gas combination, too . . . oxy-acetylene, oxy-propane, oxy-natural gas. Whatever your flame-cutting requirements, there's a complete line of dependable OXWELD torches to meet them exactly.

You can choose from the widest selection of top quality torches and nozzles ever made available—a choice that assures you of genuine OXWELD performance on every cutting job. Backed by half a century of know-how, OXWELD cutting torches and OXWELD nozzles are designed and built to give you trouble-free service, one hot job after another, year in year out.

Ask your nearby LINDE representative to *prove* OXWELD performance to you today. He'll be glad to study your flame-cutting program and demonstrate how OXWELD cutting torches can help you save. Also write for free booklet, F-1174. LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. *In Canada:* Linde Company, Division of Union Carbide Canada Limited, Toronto.

Look to LINDE . . . for the Best in Welding and Cutting Apparatus

Linde
TRADE-MARK

UNION CARBIDE

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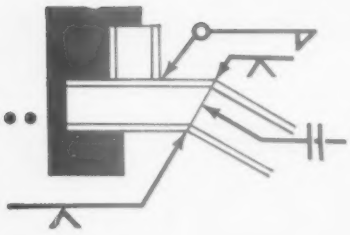


the welding clinic

Here you may find the solution to your welding problems, whether they concern design, production, construction or maintenance welding. Submit your questions for answering on this page.

Maintenance for resistance welding machines

Question:

Our firm has recently made a change to resistance welding for production work. Although we have a general idea of the maintenance requirements for these machines, we would appreciate a more complete listing of recommended practices.

Answer:

The answer to this request cannot possibly cover all the problems that may be encountered in resistance welding machines. But it may help to avoid common pitfalls which, because of poor maintenance, decrease the equipment's production rate.

The first consideration—usually not thought of as part of maintenance, but equally important—is installation and setup of the resistance welder. Before any production run, all parts and accessories should be verified and checked. (Installation is comparable to that of any other machine tool, with the exception of power supply.)

All electrical, water and air supplies must first be properly connected. *It is very important that the data on the welder's nameplate check with the line voltage, and when connecting the motor circuit, that the direction of rotation is correct.*

After installation, and prior to the first production run, the following steps should be taken:

1—Make certain water is circulating in the cooling system.

2—If air or hydraulic pressure is used, check pressure indicators.

3—Close both line and control switches and inspect current and time settings.

4—Check the welder's repeat action and the consistency of electrode force.

5—Check electrode alignment and tightness of all nuts and bolts used for clamping and positioning.

6—Be certain the machine is suited to the job; that electrical, mechanical and control systems are functioning properly, and that current, time and pressure are correctly synchronized.

The great variety of resistance welders makes it impossible to offer an extensive list of installation instructions. Following the instructions and diagrams furnished with each machine, and keeping this data for reference is very important. This is also true of instruction sheets for standard timers, control panels, etc.

So much for installation—now for actual maintenance of the machine after production has begun, as outlined by Resistance Welder Manufacturers Association.

1—Failure of the water cooling system can cause serious damage to the welder, so all water circuits should be maintained as originally furnished by the manufacturer. Water must be clean and cool (inlet temperatures should not exceed 60 F). The water system should be drained and blown out when the welder is idle during cold weather. Damaged hose sections should be immediately replaced.

2—Frequent cleaning of electrodes in the machine to remove metal particles and to keep contact points bright, plus removal of electrodes for reshaping and their replacement after reasonable wear, are all necessary to maintain good weld quality.

3—Switches, contactors and timing devices are nerve centers of a welder and should be kept in good mechanical and electrical condition at all times. No repairs should be made on these or other control units except by, or under the direction of, a competent and authorized electrician.

4—Clamps, holding devices or indexing fixtures must be in perfect mechanical condition and must be tightened, adjusted or repaired as soon as noticeable looseness or wear develops.

5—Air supply should not contain excessive moisture. If the air pressure gage and pressure designated for the job do not correspond, even after a gentle tapping of the pressure gage, the condition should be reported to the maintenance department.

6—All moving parts should be oiled and greased at regular intervals to insure smooth, even motion and minimum wear. Proper operation of motors, variable-speed drives, and clutch and reduction units is as essential to resistance welders as to any production machine. Prepare charts or instruction sheets to allocate responsibility of inspection and maintenance to proper departments.

One final consideration is shop cleanliness. Machines will operate better and require less service when good housekeeping is practiced consistently.

By observing these general practices *before*, *during* and *after* production runs, maintenance and repair costs for resistance welding machines will be kept to a minimum.

"We chose Liquidweld on all 3 counts,"

says Mr. John A. Rockelmann, President, American Boiler & Tank Co.

American Boiler & Tank Co. is among the foremost steel plate fabricators. The company fabricates tanks of all kinds, does duct work, steel smoke-stack work, and breechings.

1. POSITIVE CONTROL
LIQUIDWELD'S uniform flame, due to exclusive "Tru-Flo" needle valves, assures superior performance.

2. ON THE JOB REPAIRABILITY
LIQUIDWELD'S unique design makes possible the installation of most parts by the operator.

3. EXTRA MARGIN OF SAFETY
LIQUIDWELD Regulators have seats which stand full cylinder pressure and all LIQUIDWELD torches have more-than-ample vent holes for added safety.

Liquidweld

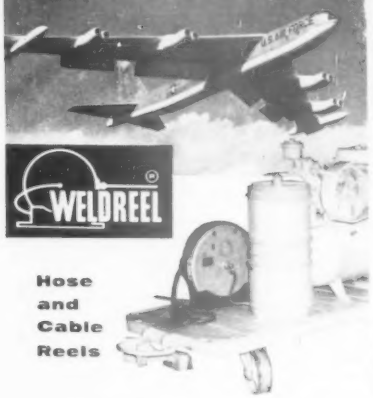
Liquid Carbonic manufactures Industrial Gases and distributes nation-wide a complete line of Arc Welders, Supplies, and Accessories. For free illustrated literature on LIQUIDWELD write

GENERAL DYNAMICS CORPORATION — LIQUID CARBONIC DIVISION

Dept. 942, 135 South LaSalle Street, Chicago 3, Illinois

See these reels at the Plant Maintenance and Engineering Show **SPACE 224**

SUPERSONIC PLANES GET FACES WASHED FASTER..... *BETTER*



WELDREEL

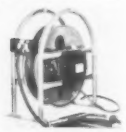
Hose and Cable Reels

SCRUBBING THE SURFACES OF PLANES to reduce friction at supersonic speeds formerly was done by several men, working laboriously with hand cleaning equipment. But the installation of cleaning units like this one, equipped with WELDREEL dual hose reels, has cut to a minimum the time and manpower required . . . *and results in better cleaning.*

Using one hose for compressed air and the other for cleanser or detergent, cleaning may be completed in a short time by one man. The reel permits hose to be paid out to the length required . . . holds it there with a self locking pawl . . . and retracts it automatically with a heavy spring.

Designed to handle flammable fluids and gases safely in dual and single hose, leakproof WELDREEL reels are adaptable to a wide variety of industrial applications. Write for full information.

MODEL OA-A holds 50′ of 3/16″ or 40′ of ¼″ dual hose. Model OAB has capacity for 150′ of ¼″ or 125′ of 5/16″ hose.



MODEL EA-2 with current capacity of 300 amps holds 50′ of 2/0 welding cable. Model EA has capacity of 100′ cable.

MODEL A-1 has 50′ capacity of ¼″ or ⅜″ I.D. single hose. The larger Model A-2 holds 50′ of ½″ hose.

UNITED SPECIALTIES INC.
POST OFFICE BOX 696 — EL DORADO, ARKANSAS

CARL Brainard used this torch when he learned to weld in 1915. Tip is new but fits aged torch perfectly.

Is this the grandpa of all welding torches? We don't know, but it's older than the 1922 model described in Welding Engineer's June article, "Does he use America's oldest torch?"

44-year use by 2 generations

—*that's the history of this torch*

BACK IN 1914, a young salesman called at the shop of Brainard Bros., Sacramento, Calif. He exhibited, demonstrated, and sold a torch to speed fabrication of the mining, logging and sawmill equipment made by the firm.

That young salesman was L. W. Stettner, a pioneer welding torch and safety regulator inventor, now president of Victor Equipment Co. The torch he sold that day is still on the job, even though constant use has worn away the serial number it once bore.

But its age is revealed by the title, "The Great Western Welding and Cutting Co.," stamped on the control valve. For it was at Great Western that Stettner invented his first torches. Shortly after he made his sale to Omar Brainard, Great Western changed its name to Victor.

After reading "Does he use America's oldest torches?", a retired Victor salesman, 81-year old Harry Peterson, recalled selling another piece of equipment to the Brainards. It was a cutting attachment manufactured in 1920. On the handle of this old-timer can still be read the serial number "185," which dates it as the 86th attachment turned out by the firm, since serial numbers began with 100. Both cutting attachment and torch handle have been used almost every working day since their purchase.

When Peterson offered to exchange a new unit for this welding veteran so it might be retired to Victor's museum of early welding apparatus, he uncovered yet another old-timer—a regulator he had sold to the company in 1926.

Carl Brainard, son of Omar, who learned to weld with a Victor torch in 1915, says this V50 regulator was the first to be used for heavy cutting in the Sacramento area.

Says Carl, "Our first welding torch was a Victor, single-valve operated, and the cutting head was No. 185. They were in good working condition when we closed our machine shop operations in July, 1958.

"I first learned to weld with a Victor torch when I was 14 years old. Since that time we have tried other torches in our shop, but my first love was a Victor and we have stuck to them ever since."

PORTRAIT of five welding veterans. *Left:* Carl Brainard, weldor for 43 years. *Center:* 44-year-old torch handle and 38-year-old cutting attachment. *Background:* 32-year-old V50 regulator. *Right:* 81-year-old Harry Peterson.

MESSAGE #4 *This message is for men who are vitally concerned with such welding problems as maintaining a smooth flow of production... preventing excessive rejects... and insuring trouble-free, economical, profitable operation*

Welding Wire: Cost-saving and Profit Factors

Production men who are conscious of *both cost and quality* agree that a top-grade weld demands the *right* welding wire. *Only* by using wire with an analysis suited to the material to be welded can consistently sound welds—free from porosity and internal cracks—be produced. Use of the right wire means fewer rejects, less waste, lower costs—plus a better finished part or product.

Experienced welding men have long found PAGE a most reliable source of welding wire for all their regular and special needs. The wide range of PAGE analyses—33 of them—makes it possible to select the exact wire that produces the kind of welds that lower production costs and increase profits.

PAGE experience, talents and facilities are available to you at all times. We have been exclusive wiremaking specialists for more than half a century, and are in an ideal position to furnish our customers with the right wire for each specific need. Furthermore, we have developed a broad packaging program which saves time and money by supplying wire packaged to meet any requirement.

These factors, plus PAGE's nationwide set-up of conveniently-located distributors, backed up by PAGE warehouse stocks, help make it profitable for you to standardize on PAGE Welding Wire.

PAGE offers—
33 ANALYSES
...the right analysis for your welding job

There are *33 different analyses* in the PAGE line, covering the broadest range of applications: submerged arc...inert gas...tungsten or metal arc...oxy-acetylene gas welding...metal spraying.

For example—

ANALYSIS A-S-6...This mild steel wire is used for welding mild steel where exceptional ductility is required. Its high elongation is obtained by holding the carbon (.06), manganese (.15) and silicon (.03) to the very low maximum given in parentheses. Analysis A-S-6 is very close in physical properties to AS-Armco. Used either with inert gas or a neutral flux, it will give clean non-porous welds averaging 50,000 p.s.i. tensile and 35% elongation with a Rockwell Hardness of B-65. Analysis A-S-6 is also used for PAGE C Gas Welding Rods for oxy-acetylene welding, where it is the most generally used of all gas welding rods. PAGE C gas welding rods, used with a neutral flame, will give the same physicals as A-S-6.

For example—

ANALYSIS A-S-17...Analysis A-S-17 is a modification of the most popular submerged arc welding wire—PAGE A-S-10, which contains only a trace of silicon. In A-S-17, silicon is deliberately added up to .20% for use with inert gas. The added silicon is a strong deoxidizer, scavenging the molten metal and giving a strong weld free from porosity, together with cutting down spatter and, through a more stable arc, giving deeper penetration. All of this leads to higher physicals: up to 65,000 p.s.i. tensile and 30% elongation. It is recommended for CO_2 inert gas welding of low carbon steels, rather than A-S-10.

NOTE: previous advertisements in this publication have included brief descriptions of PAGE Analyses A-S-8620, A-S-6150, A-S-30, A-S-NAX-9115, A-S-65 and A-S-Armco Iron.

Write for—Welding Wire **Comparison Chart DH-1218** (shown above). This highly informative, four-page chart lists detailed analyses of PAGE automatic welding wires, metal spray wires, bare electrodes and gas welding rods. Also shows uses and physical properties, including: tensile strength, elongation, Rockwell hardness. Chart lists virtually all competitive makes.

Write for—Submerged arc and inert gas welding wire **Folder DH-402A**...also gas welding rod **Booklet DH-1277.**

• • •

PAGE offers—
Packaging to meet your needs

PAGE Welding Wires are packaged in a wide variety of ways—for the most complete protection and the utmost convenience in handling, in stocking and in use. Here are some major types of PAGE packaging:

1. **Paper-wrapped Coils**
2. **Coils in Cartons, Palletized**
3. **Bare Coils (packed in Leverpaks)**
4. **Masonite Reels**
5. **Payoffpaks**
6. **Payoffpallets**
7. **Gas Rods in Burlap-wrapped Bundles**
8. **Stainless Gas Rods in 10-lb. Tubes**

For example—

PAYOFFPAKS...Up to 700 lbs. of wire, without a single weld...coiled around a fiberboard cylinder within a fiberboard drum...ready to be smoothly unreeled to the welding head for automatic or semi-automatic welding! Eliminates costly machine down-time for coil replacement. Payoffpaks come in three sizes: 20" diameter (holds 250 or 500 lbs.); 23" diameter (holds up to 700 lbs.).

Write for—**PAGE Welding Wire Packaging Chart.** • This useful chart shows the many kinds of packaging of PAGE Welding Wires for each type of welding.

• • •

PAGE offers—
Availability from local stocks

Here is a handy service that not only gets you the welding wire you need when you need it, but saves you money by making it unnecessary for you to tie up a sizeable investment in wire inventory.

You can get the exact PAGE automatic welding wire and welding rods your job requires direct from your nearby PAGE Distributor. Located at many points from coast to coast, PAGE distributors carry sizeable stocks for your convenience—and they are backed up by PAGE Warehouses at the strategic locations shown below. Close cooperation between PAGE distributors, PAGE warehouses and the PAGE mill is your guarantee of prompt, intelligent, individual service on your specific needs.

ACCO

TRADE MARK

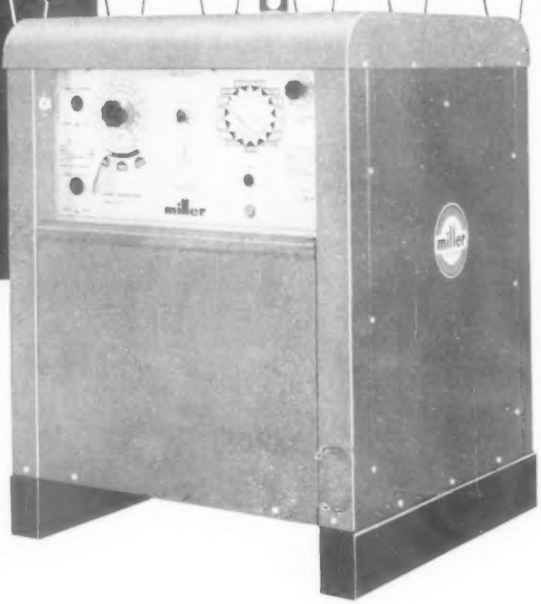
Page Steel and Wire Division
AMERICAN CHAIN & CABLE

Monessen, Pa.*, Atlanta, Chicago*, Denver*, Detroit, Houston*
Los Angeles*, New York, Philadelphia*, Portland, Ore.
San Francisco*, Bridgeport, Conn.
*Indicates PAGE warehouse stocks

ACCO for Better Values

NEW miller BALANCED WAVE

ELECTRIC CONTROL WELDER



Brings out BEST in TIG Welding

This new Miller development improves quality, speed and range of tungsten inert gas welding in all automatic fixture and manual applications. Balanced wave (BW) characteristic results from a new Miller balance control which eliminates the d-c component present in most welding currents. Output of the Miller BW welder is ONLY pure a-c, DELIVERS:

Excellent arc stability

Maximum heat

Deeper penetration

Faster welding speeds

Complete particulars will be sent promptly upon request.

miller ELECTRIC MANUFACTURING COMPANY, INC., APPLETON, WISCONSIN

Distributed in Canada by Canadian Liquid Air Co., Ltd., Montreal

EXPORT OFFICE: 250 East 57th St., New York 19, N. Y.

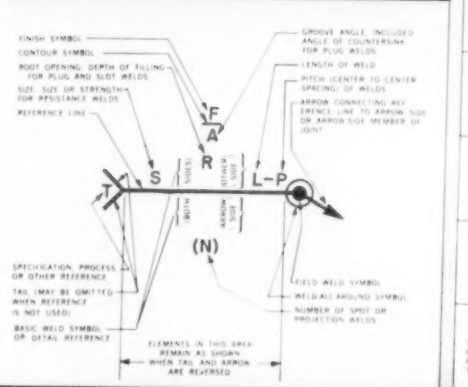
Basic Weld Symbols and Their Location Significance

LOCATION SIGNIFICANCE	ARC AND GAS WELD SYMBOLS															RESISTANCE WELD SYMBOLS			
	FILLET	PLUG OR SLOT	ARC SEAM OR ARC SPOT	GROOVE: SQUARE	GROOVE: V	GROOVE: BEVEL	GROOVE: U	GROOVE: J	GROOVE: FLARE V	GROOVE: FLARE BEVEL	BACK OR BACKING	MELT-THRU	SURFACING	FLANGE: EDGE	FLANGE: CORNER	RESISTANCE SPOT	PROJECTION	RESISTANCE SEAM	FLASH OR UPSET
ARROW SIDE													NOT USED			NOT USED		NOT USED	NOT USED
OTHER SIDE													NOT USED			NOT USED		NOT USED	NOT USED
BOTH SIDES		NOT USED	NOT USED								NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
NO ARROW SIDE OR OTHER SIDE SIGNIFICANCE	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED		NOT USED	NOT USED		NOT USED		

Supplementary Symbols

WELD ALL AROUND	FIELD WELD	CONTOUR: FLUSH	CONTOUR: CONVEX
○	●	—	⌒

Location of Elements of a Welding Symbol


FINISH SYMBOL
CONTOUR SYMBOL
ROOT OPENING; DEPTH OF FILLING FOR PLUG AND SLOT WELDS
SIZE; SIZE OR STRENGTH FOR RESISTANCE WELDS
REFERENCE LINE
GROOVE ANGLE; INCLUDED ANGLE OF COUNTERSINK FOR PLUG WELDS
LENGTH OF WELD
PITCH (CENTER TO CENTER SPACING) OF WELDS
ARROW CONNECTING REFERENCE LINE TO ARROW SIDE OR ARROW SIDE MEMBER OF JOINT
F
A
S
R
L-P
T
(N)
SPECIFICATION, PROCESS OR OTHER REFERENCE
TAIL (MAY BE OMITTED WHEN REFERENCE IS NOT USED)
BASIC WELD SYMBOL OR DETAIL REFERENCE
FIELD WELD SYMBOL
WELD-ALL-AROUND SYMBOL
NUMBER OF SPOT OR PROJECTION WELDS
ELEMENTS IN THIS AREA REMAIN AS SHOWN WHEN TAIL AND ARROW ARE REVERSED

Typical Welding Symbols

BACK OR BACKING WELD SYMBOL

SINGLE-V GROOVE WELDING SYMBOL INDICATING ROOT PENETRATION

PROJECTION WELDING SYMBOL

SURFACING WELD SYMBOL INDICATING BUILT-UP SURFACE

DOUBLE-BEVEL GROOVE WELDING SYMBOL

RESISTANCE SEAM WELDING SYMBOL

DOUBLE-FILLET WELDING SYMBOL

WELDING SYMBOLS FOR COMBINED WELDS

FLASH OR UPSET WELDING SYMBOL

CHAIN-INTERMITTENT-FILLET WELDING SYMBOL

PLUG WELDING SYMBOL

BRAZING, FORGE, THERMIT, INDUCTION AND FLOW WELDING SYMBOL

STAGGERED INTERMITTENT-FILLET WELDING SYMBOL

SLOT WELDING SYMBOL

MELT-THRU WELD SYMBOL

SINGLE-V GROOVE WELDING SYMBOL

RESISTANCE-SPOT WELDING SYMBOL

EDGE- AND CORNER-FLANGE WELD SYMBOLS

Supplementary Symbols Used with Welding Symbols

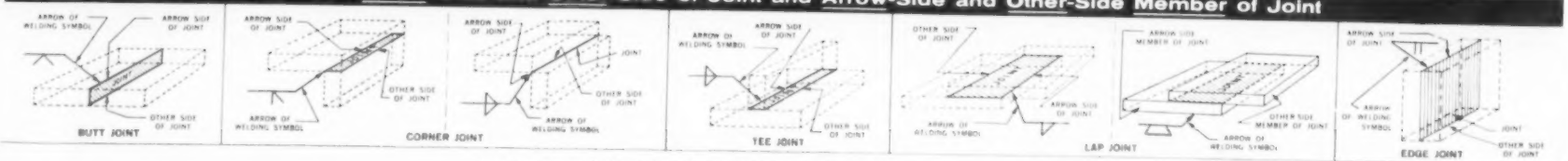
WELD-ALL-AROUND SYMBOL

FIELD WELD SYMBOL

FLUSH-CONTOUR SYMBOL

CONVEX-CONTOUR SYMBOL

Basic Joints—Identification of Arrow Side and Other Side of Joint and Arrow-Side and Other-Side Member of Joint



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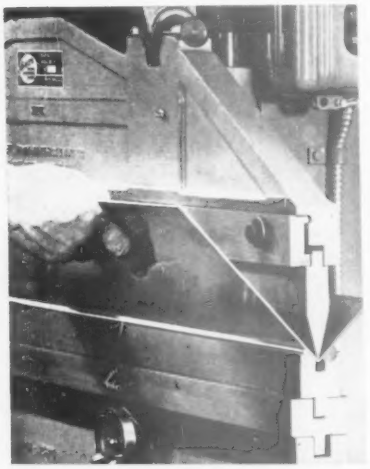
new products . . . use card on page 111

MACHINES FOR PRODUCTION . . .



Press brake die

FEMALE press brake die with roll inserts that eliminate work marking, reduce die set-up and changeover time can be used in any mechanical or hydraulic press brake or punch, says manufacturer. Die block of Di-Acro Rol-Form Dies house two hardened and ground, half-round inserts which roll up and toward opening in die block as male die enters materials to be formed. Four standard styles varying in size from ¼ to 1 in. are available. Maximum degree of bend which can be formed is 60 deg. Up to 12 cft standard lengths can be obtained for press brakes. *O'Neil-Irwin Mfg. Co.*

Circle No. 1

Lapping machine

No. 31 Crank-O-Lap crankshaft lapping machine produces fine surface finishes by means of coated abrasive strips on external diameters of automotive type crankshafts. It laps pins and bearings simultaneously in an automatic cycle to low micro-inch readings. Originally developed for finishing crankshafts, machine is also said to be suited for finishing other types of parts. *Norton Co.*

Circle No. 2

Work holder

PG Semi-Matic work holder is said to increase polishing and buffing output. To operate, one simply loads the work and advances it to the wheel. Machine holds the work in place, turning and oscillating it across wheel. Machine stroke is adjustable to a maximum of 12 in. Three-speed spindle is 1½-in. in diameter and 3 in. long. *Divine Bros. Co.*

Circle No. 3

Portable bender

MIGHTY Midget portable bender is powerful enough to bend a strip of cold-rolled steel ⅛-in. thick into nearly any shape, says manufacturer. Principle of the screw is employed to exert up to 2,000 lb of pressure to form metals against Midget's interchangeable curve and angle dies. Wire, brass, aluminum, steel or other metals up to ⅛-in. thick and 1¼-in. wide may be bent. *Shat Mfg. Corp.*

Circle No. 4

Tube cutter

MANUALLY operated, portable, tube cutting machine is designed to fit into smaller shops where production runs do not require expensive machinery. Model NTD 6 has capacity for 6-in. standard pipe, and the same numerous types of cuts are accomplished as with power-driven models. *Nickelson Tool & Die Co., Inc.*

Circle No. 5

Cutting unit

NEW cut-machining unit is said to cut wet and effortlessly. One push of a button starts clamping, movement of cutting head and coolant flow. Rate of saw travel can be regulated to suit material being cut. Three sizes have 16, 18 or 20-in. wheels and 7½, 10 or 15-hp motors. Tubular capacity is 4½, 5½ and 6 in. OD, round bar capacity is 2½, 3 and 4 in., square bar, 2, 2½ and 3-in. *Wallace Supplies Mfg. Co.*

Circle No. 6

Hand grinder

DOALL Model DH-612 precision surface grinder is designed for tool room and production work. Machine has a 6-in. adjustment that permits best height selection for operator, whether sitting or standing. Machine is powered by one hp spindle, and includes a versatile coolant system that permits both flood coolant and DoAll's exclusive cool grinding through the wheel. Slip rings for zeroing both downfeed and crossfeed handwheels are also available. *DoAll Co.*

Circle No. 7

Driver-drill

TWO-WAY power tool is a high-torque screwdriver which converts to ⅜-in. drill. Includes two bits and finders, finder cap, spring, auxiliary side handle and 7-ft cord. *Millers Falls Co.*

Circle No. 8

Nibbler

NIBBLER able to cut aluminum, stainless steel and all types of plain corrugated metals can now cut metals that have asbestos or pitch coating without clogging machine. Portable nibbler can operate off a 100-volt circuit, with its 1¼-hp motor delivering a two-ton punch. Depressed punch makes it impossible for operator's fingers to come in contact with it. Nibbler comes in both air-powered and electric models. *Fenway Machine Co.*

Circle No. 9

Proof! You don't have to lose the advantages of Inco Nickel Alloys at a joint

Inco welding products match their properties

Take this job for example.

The weldor above is shown joining strips of Monel* nickel-copper alloy to form the anchor parts for a new salt water cooling tower. G. W. Galloway Company is building this tower for The California Oil Company at Perth Amboy, N. J. Monel alloy is being used to lick the salt water corrosion problem. To get weld metal to match the corrosion resistance and strength of this nickel-copper alloy, Galloway is using Inco's "60"* Monel Filler Wire.

It's a wise decision, too . . . to buy filler wire from the same people who developed Monel alloy. After all, who would know how to weld Inco Nickel Alloys better than the people who developed them?

Wide range of Inco-developed electrodes available

There's a full range of Inco welding products available for oxyacetylene, inert gas metal-arc, and metal-arc welding. From these, the right material can be selected to match the properties of any Inco Nickel Alloy you may be joining.

Get top results!

On your next job make sure you use Inco welding products to join Inco Nickel Alloys. Look under "Nickel" in your classified telephone directory to find out where you can buy Inco welding products.

And write for "Inco Welding Products" for requirements, applications, specifications. Write:

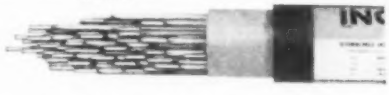
*Registered trademark

THE INTERNATIONAL NICKEL COMPANY, INC.

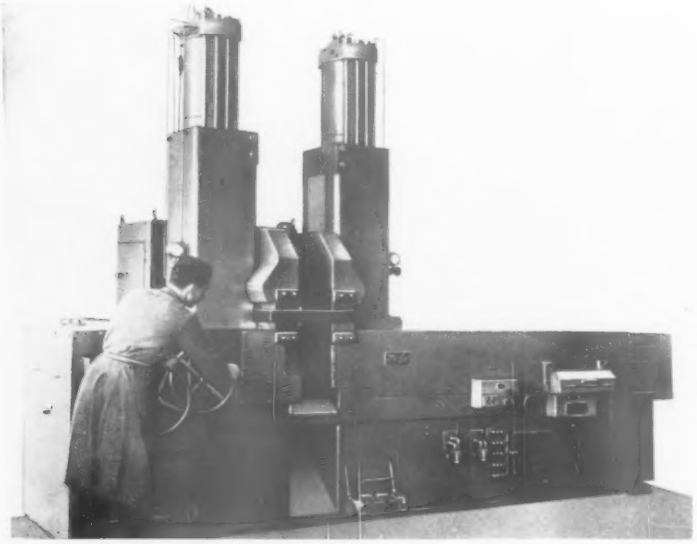
67 Wall Street — INCO — New York 5, N. Y.

INCO WELDING PRODUCTS

electrodes • wires • fluxes



new products . . .



Flash welder

ASEASVETS type SVU automatic welding machines are equipped with hydraulic clamping and motor-operated upsetting with maximum welding section capacities of 40 sq in. Automatic control, operated through weld temperature and slide distance, permits predetermination of exact weld length and maintains uniformity of welds when abutting surfaces are uneven. *ASEA Electric Inc.*

Circle No. 10

Test chamber

ULTRA-low temperature environmental test chamber provides 13 cu ft of space and automatically maintains internal temperature at any level in the range from —20 F to —260 F. Refrigeration is produced by company's gas liquefier and a circulating air system transfers the cold from the header to the test chamber. Manufacturer says installation is important to missile and space research programs where cold conditions must be simulated. *Philips Electronics Inc.*

Circle No. 11

Torch holder

MODEL 64-2 Gasaver with leak-proof valves is a torch holder and is said to be a gas economizer. When torch is placed on hook flame is automatically extinguished. Stationary pilot light provides means for relighting torch. *Harris Calorific Co.*

Circle No. 12

Ultrasonic welder

SONOWELD 2,000-watt ultrasonic production welder is said to weld, without fusion, similar and dissimilar metals and thin gages of materials which defy conventional welding methods. The solid state joining process has ultrasonically bonded, both to themselves and to other metals, molybdenum, niobium, tantalum, thicknesses of 0.050-in. 1109-H-aluminum and 0.025-in. 316 stainless steel. The semi-portable spot welder requires less electrical power than resistance welding, operating on a 230 volt circuit while consuming a maximum power of 3.5 kva. *Aeroprojects Inc.*

Circle No. 13

Arc welder

BUDGET 500 is a new a-c transformer type arc welder rated 500 amps. at 40 volts on 60% duty cycle. It has a welding range of 100 to 625 amps in three overlapping main step settings of 100 to 300 amps, 195 to 475 amps and 375 to 625 amps. Rheostat control provides fine adjustment so open circuit voltage to suit each job may be chosen. Transformer uses Diverter-Path principle. Double primary provides for operation on either 230 or 460 volts. No high voltage appears across any control coils, eliminating possibility of insulation breakdown or high voltage appearing under rheostat handle. *Hobart Bros.*

Circle No. 14

Aluminum studs

ALUMINUM fastener studs up to $\frac{1}{2}$-in. in diameter can be welded to aluminum plate with new portable equipment that eliminates hand arc-welding, drilling, etc. Studs are end-welded with NS-104 stud welding gun that has a special adapter foot. Either argon or helium flows through and surrounds weld area when welding. Studs are made from 4043 aluminum alloy, in lengths up to 3-in. and diameters of 3/16, $\frac{1}{4}$, 5/16, $\frac{3}{8}$, 7/16 and $\frac{1}{2}$-in. Tensile strength is 15,000 to 25,000 psi. Aluminum alloys which may be welded include 1100, 2024, 3003, 3004, 5052, 5154, 5086, 6061 and 6063. Minimum plate thickness is $\frac{1}{8}$-in. *Gregory Industries Inc.*

Circle No. 15

X-ray amplifier

THREE basic units compose X-ray amplification system for inspection of industrial equipment and products. Amplifier produces an image several hundred times brighter than a conventional fluoroscope image. The three units, an electronic image amplifier, X-ray generator and control, produce a bright image that enables inspectors to work in normally lighted rooms.

System can be used to inspect moving parts, such as gears or engines. It gives good definition of products moved 12 ft per minute past camera. Extra monitors can be placed in various locations to permit simultaneous inspection, and remove radiographer from radiation exposure. A 16mm camera is mounted so it can make a permanent record of the inspected item. *Picker X-Ray Corp.*

Circle No. 16

Portable welder

MODEL 200A-25, a 200-amp welder weighing 419 lb, is air-cooled and has a two-cylinder, four-cycle gasoline engine. Main current tap switch has 12 basic settings from 45 to 200 amps, and a fine control rating that can be set to deliver proper heat to weld any metal. Average fuel consumption is less than $\frac{3}{4}$ gallon per hour, says manufacturer. *A. O. Smith Corp.*

Circle No. 17

Welder

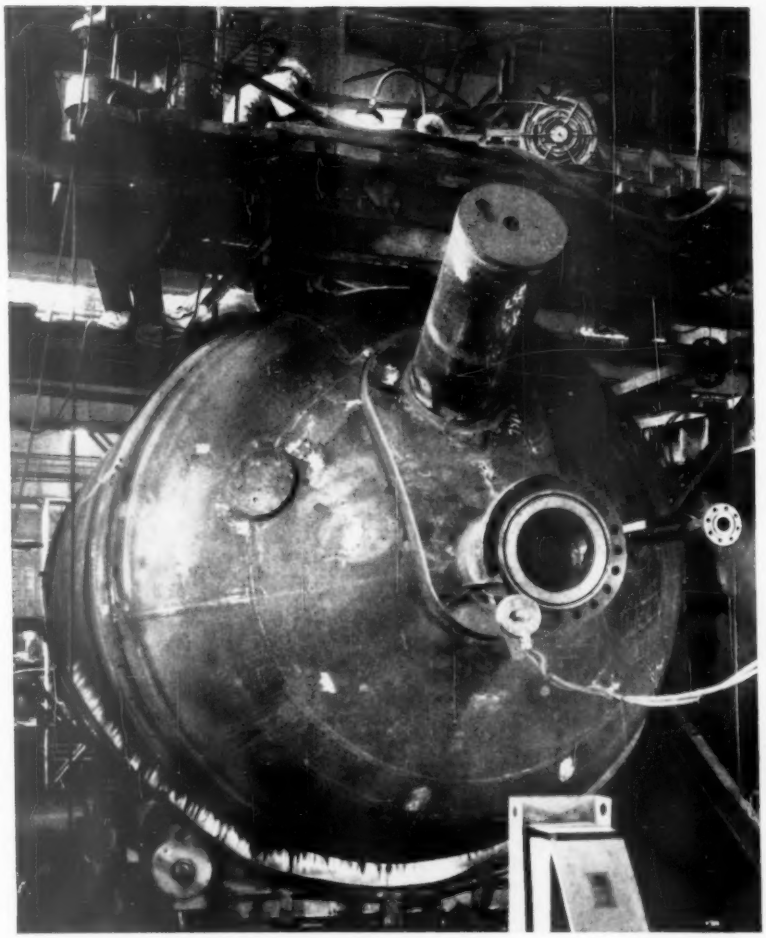
A-C WELDER is designed for jobs within 20 to 180 amps range. Machine has 16 steps of heat and high open circuit of 65 volts that permits use of low hydrogen and stainless steel electrodes up to 3/16-in. Supplies 230 volts of power, 50-60 cycle, single phase and has a full load input of 37 amps. Meets all NEMA and REA specifications, says manufacturer. *Harnischfeger Corp.*

Circle No. 18

For any stainless welding job

SPECIFY *Drawalloy* CORPORATION

Stainless Steel Welding Wire



Spooled for Inert Gas Shielded Metal Arc Welding

Coiled for Submerged Arc Welding

Cut Lengths for Inert Arc Welding

Specify Drawalloy "quality controlled" stainless steel welding wire for *your* next "quality weldments." Your greatest advantage is experience . . . our experience in producing wires for welding exclusively. Because we are specialists, Drawalloy stainless steel welding wire is produced to strictly controlled specifications to provide the right chemistry, finish and temper for the finest quality weld metal and smoother operation in your automatic or semi-automatic equipment. Drawalloy stainless wires are available in all popular grades as well as 2¼ Cr, 1 Mo; 1¼ Cr, ½ Mo.

Why not discuss your stainless welding wire needs with your Drawalloy Distributor or Representative . . . a man with the products and knowledge to help you. Bulletin 355 DC provides complete information on every grade of Drawalloy wire. Write to: Drawalloy Corporation, Lincoln Highway West at Alloy Street, York 12, Penna.

DRAWALLOY
CORPORATION
YORK, PENNSYLVANIA

THE WIRE MILL FOR THE WELDING INDUSTRY — STAINLESS STEEL · TOOL STEEL

Forming machine

MELTLMASTER is a versatile sheet metal shear and forming machine. Square shearing, circle shearing up to 49-in. diameter inside throat, and contour shearing of metal up to 9/32-in. thick can be performed in addition to flanging, beading, joggling, slot cutting and louvering. Inside cuts can be made without a starting hole. *Lennox Tool & Machine Builders.*

Circle No. 19

Induction heating

APPLICATIONS of low-frequency heating system has been expanded by company. New units are portable and are for automatically controlled, precision heat treating and preheating. Three types of heating are available—low voltage-high current, high voltage-low current and resistance. *Electric Arc Inc.*

Circle No. 20

Cable reel

A NEW self-retracting welding-cable reel is designed to hold 50 ft of 2/0 cable, with a current capacity of 300 amps with 60% overload factor. Weldreel Model EA2 is equipped with a heavy duty retracting spring. To rewind cable, release locking pawls by tugging cable, spring will do rest. Unit is easily mounted on walls, floor, ceiling or mobile equipment. Cable life is said to be lengthened, but new cable can be easily inserted. *United Specialties Inc.*

Circle No. 21

Recovery unit

FLUX recovery unit Model F 85 can be arranged for continuous pick-up and feed-out. It is equipped with brackets for overhead mounting and a slag screen to filter fused particles. Comes in three models with horsepower ranging from $\frac{3}{4}$ to $1\frac{1}{2}$, velocity from 270 to 325 mph and volume from 190 to 230 cfm. Recovery rate ranges from 20 to 30 lbs per minute. Flux capacity on all three models is 100 lb, but a 150 lb hopper can be attached. *American Vacuum Co.*

Circle No. 22

Gas appliances

COMPANY has added complete line of LP-gas appliances to Prest-O-Lite soldering, heating and brazing equipment. New equipment includes open-flame torch stems in six sizes and enclosed-flame soldering iron, all of which fit on three styles of torch handles designed to operate in both air-acetylene and LP-gas service. Also included are pressure regulator, melting furnace and double-duty hose assemblies. Regulator can deliver from 1 to 60 psi. *Linde Co.*

Circle No. 23

Liquid flux

JET (liquid) Flux, for torch brazing in production where automatic fluxing systems are used, eliminates after-cleaning, says manufacturer. Use of flux is said to reduce cost of production, flux and clean-up. Jet Flux is stocked in 5-gallon cans and 55-gallon drums. A single gallon is said to last an average of 80 torch hours of steady brazing. *All-State Welding Alloys Co., Inc.*

Circle No. 24

Gouging electrodes

GROOVES, electrodes for gouging, piercing and metal removal, can be used with a-c or d-c welding units without oxygen or air supplies. Holes up to $\frac{3}{4}$ in. in diameter in $\frac{1}{2}$-in. steel plate can be made. *Aufhauser Bros. Corp.*

Circle No. 25

This on-the-job test reports:

"Cooler . . . lasts 3 times as long"

Spot Welder No. 89 | Service Welder No. 199 | Welder's Mitten No. 98

Riegel

WELDER'S GLOVES

"The Riegel No. 99 Heavy Welder lasts six weeks against two weeks for the glove we used formerly. The men tell us it's more comfortable and cooler."

So reports Mr. Richard Thornell, whose switch to Riegel now saves $35.00 yearly per man at Oliver Corporation, Springfield, Ohio.

No. 99 facts: Heavy but flexible "flextan" welders' leather, gunn cut, wing thumb. Extra roomy, extra long. One-piece back, wool-insulated . . . all exposed seams welted . . . full protection against heat and sparks.

Riegel has the service you want, too . . . industrial specialists to help select the right style . . . eight warehouses to speed delivery. Write or phone today.

INDUSTRIAL GLOVE SALES

RIEGEL TEXTILE CORPORATION

CONOVER, N. C.

Sales Offices in:
Birmingham • Chicago
Detroit • Los Angeles
New York City

Riegel
... GLOVES THAT WEAR ON WHERE OTHERS WEAR OUT

Warehouses in:
Chicago • Conover, N. C.
Detroit • Greenville, Ala.
Los Angeles
New York (Paterson, N. J.)
Oklahoma City
Portland, Ore.

For 27 Years Preferred By Welders

THE DURO "STANDARD"

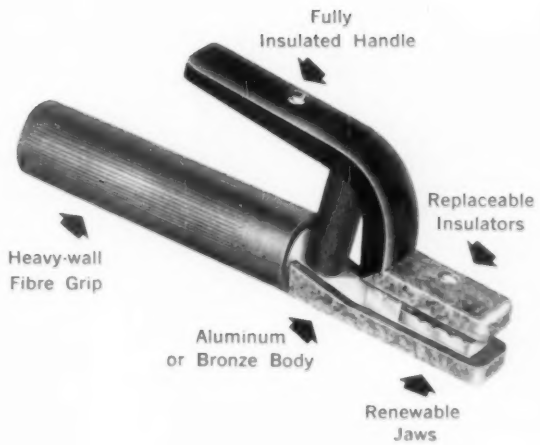
- All Parts quickly replaced with a screwdriver
- Screw-in type jaws — No tools required
- Insulated Handle and Guard — Protects operator
- Rugged Fibre Handle — Lasts longer
- Cool Operation — Cool Handling

Featuring "Long Jaw design" for reaching those "hard to get at places"

The New Duro "DUROGON" Tong-Type

THE DUROGON-N3 and N3HD

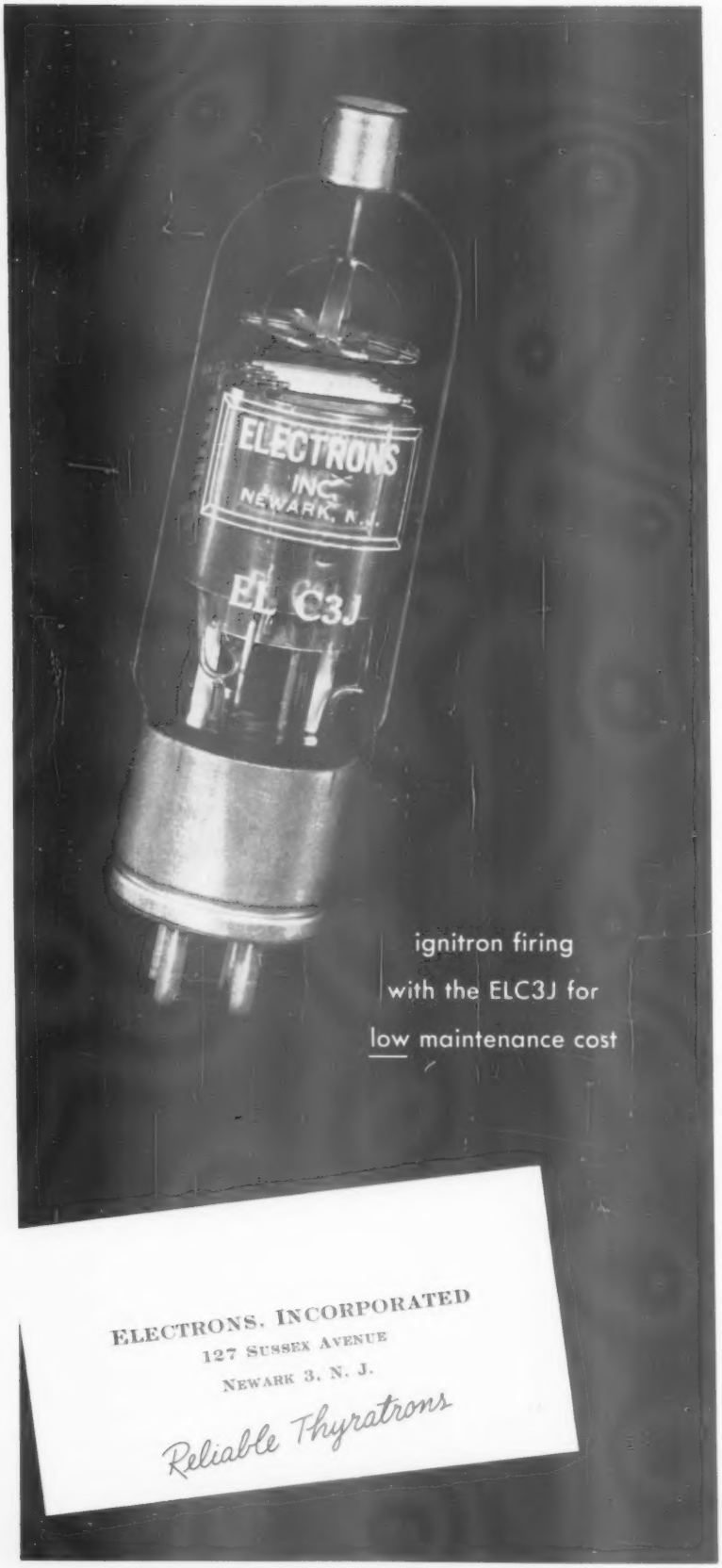
- All Parts quickly replaced with a screwdriver
- Fully Insulated — Greater safety
- Cool Operation — Cool Handling
- With ALUMINUM Body — Less operator fatigue
  Mechanical Cable Connection
- With BRONZE Body — For heavy duty operation
  Mechanical, soldered or brazed connection

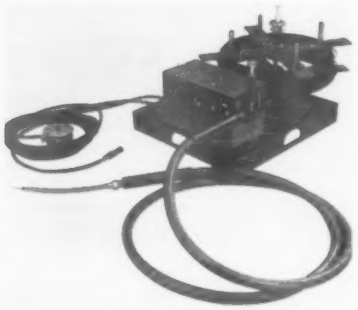


"The BEST of this Popular Design!"

DURO

ENGINEERING COMPANY · 31 OREGON AVE. · HAMDEN, CONN.





Portable welder

PORTA-WELD is a portable, semiautomatic hardfacing welder. It is designed for both 12 in. reels and pay-off bulk spooling in 3 and 4 in. widths, 12 in. in diameter. Wire sizes 3/32, 7/64 and 1/8 in. in all semiautomatic hardfacing alloys can be used. Dual rod reel and power drive assemblies are mounted on a 16 by 18-in. base. *Hensley Equipment Co., Inc.*

Circle No. 26

Gas welding

COMPANY has new, versatile inert-gas welder for production welding of reactive materials such as zirconium, tantalum and columbium. Unit is for manual or semiautomaitc welding. Type 742 has dual welding positions with glove ports, sight glasses, automatic welding shields and lights. It also includes an inert-gas backfill system, hand torches or stationary electrodes with power supplies, and a high-speed, high-vacuum pumping system. *General Vacuum Corp.*

Circle No. 27

Vulcanizing kit

PORTABLE, 110 volt vulcanizing kit can quickly make water-proof, Neoprene-insulated, heavy duty cable connections on the job or in the field, claims manufacturer. Five steps are needed to permanently seal metal connectors and electrical cables in Neoprene insulating sleeves. When cable connectors lock, connection is water and shock proof, full power is delivered but may be disconnected instantly. *Cam-Lok Div.*

Circle No. 28

Sheet aluminum

ALUMINUM alloy 5083, a weldable magnesium-manganese alloy, is now available in sheet form. In this form the alloy can be used in applications requiring high resistance to mechanical damage and corrosion, such as for processing equipment and highway guard rails. The sheet is said to offer high strength weldability, similar to 5083 plate which has been approved by the ASME for welded unfired pressure vessels. The sheet is available in O, H32 and H34 tempers. Properties in H34 temper are said to be approximately equivalent in strength to mild carbon steel. *Kaiser Aluminum & Chemical Sales Inc.*

Circle No. 29

4 Reasons why he likes to weld in this AO CAPE SLEEVE AND BIB!

1. SECURITY

AO chrome tanned cowhide leather is selected for protective quality and wear resistance. Leather is of correct weight for maximum protection and comfort and is uniform in thickness — will withstand hard use.

2. DESIGN

The garment is designed by experts working closely with experienced welders. No excess leather anywhere to form "pockets" that might catch sparks.

3. SEAMS

No more than absolutely necessary and those are located well away from the line of fire. Are *flat* type for comfort, double thread sewed, then wire stitched for double protection.

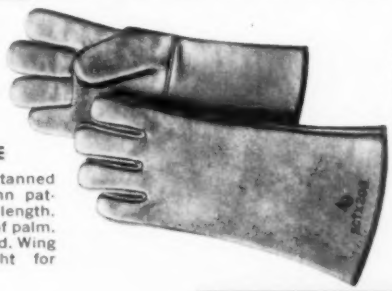
4. FASTENERS

The finest snap type available . . . large, durable . . . easy to open and close . . . insure tight, safe closures.

208BCL — CAPE SLEEVE WITH DETACHABLE BIB

Protects arms, chest, shoulders. All seams double cotton stitched and steel sewed. Seam ends rivet reinforced. Bib attached to cape with snap fasteners and is easily replaceable. Anchor button at armpits prevents cape from unbuttoning. 5 sizes. Your nearest AO Safety Products Representative can supply you.

Put the Best on His Hands Too with Specially Tanned AO Welders' Gloves



SCTX200 GLOVE

Specially chrome tanned split cowhide. Gunn pattern, 14" overall length. Flat seam at base of palm. One-piece back lined. Wing thumb. Lightweight for working ease.

SC5X163 GLOVE

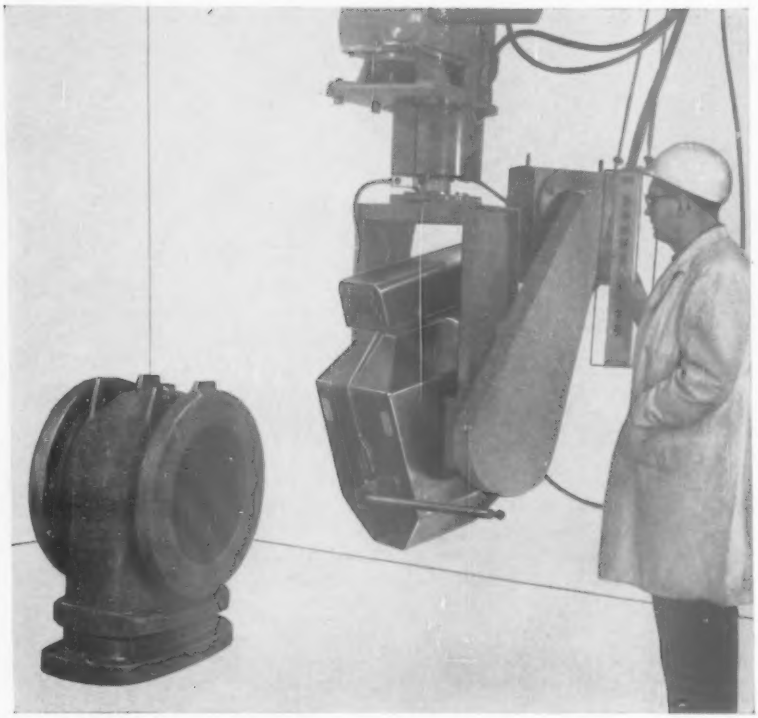
Exceptionally resistant to heat — protects on gas welding and heaviest amperage electric welding. Specially chrome tanned split cowhide. One-piece back and palm. Welted at all vulnerable seams for extra protection. Extra heavy lining on back of hand. Overall length 14".

Always insist on ® Trademarked Safety Products

American ® Optical COMPANY
SAFETY PRODUCTS DIVISION

SOUTHBRIDGE, MASSACHUSETTS
Branches in Principal Cities

1833-1958 • 125 LEADERSHIP YEARS



NOW . . . GAMMA RADIOGRAPHY THROUGH ONE FOOT OF STEEL!

Dominion Foundries and Steel Limited, Ontario, Canada, is currently using gamma radiography to inspect steel castings up to 12" thick.

The machine doing the job is Nuclear Systems' Model 1060 Multitron, which has a capacity of 1,000 curies of Cobalt 60, and which gives results comparable to those of a 2,000,000 volt X-ray machine . . . at less than ⅓ of initial equipment cost.

Provided with completely fail-safe automatic controls, the beam producing 1060 is easily and safely operated from a remote control panel.

Call on Nuclear Systems for your radiography equipment needs. Offices in Philadelphia, Chicago, San Francisco and Los Angeles. Sales representatives in principal cities. Catalog and reprint upon request.

WRITE FOR FREE REPRINT WHICH TELLS THE STORY OF LARGEST COMMERCIAL RADIOGRAPHY MACHINE IN USE.

NUCLEAR SYSTEMS
A DIVISION OF THE BUDD COMPANY, Philadelphia 32, Pa.
IN CANADA—TATNALL MEASURING AND NUCLEAR SYSTEMS, LTD.
46 HOLLINGER RD. • TORONTO 16, ONT.
Budd

Hardening powder

ROYAL hardening powder comes in shaker can that enables workman to apply powder without touching particles. Powder produces 0.01 to 0.20-in. case depth with necessary Brinnell toughness on large and small low-carbon steel tools and parts, says manufacturer. To use, shake powder on heated work, allow to liquidize and cool in regular manner. *Anti-Borax Compound Co., Inc.*

Circle No. 30

Generator

MODEL HH-25 is a totally enclosed industrial radio frequency generator for metal hardening, drawing, melting and brazing applications. It has a minimum output rating of 25 kw at a nominal frequency of 450 kc. A built-in air to water heat exchanger allows safe operation under most adverse operating conditions, says manufacturer. *Welduction Corp.*

Circle No. 31

Aluminum cleaner

ALUMINUM cleaner GH-30 cuts through grease, grime and dirt in short time, says manufacturer. It is guaranteed not to harm user, contains no harmful acids or caustic sodas and will not etch or scratch aluminum. Cleaner can also be used on stainless steel. *Chemco.*

Circle No. 32

Percussive welder

SYSTEM for end welding studs to light-gage metals operates on a stored-energy principle which discharges its current and end welds a fastener in 6/1,000 of a second. PS-1 percussive stud welding unit will weld small studs and fasteners to various combinations of nonferrous metals. It welds

diameters up to 3/16-in. Fasteners can be welded to highly polished stainless steel, coated or enameled sheet and other metals without distortion, warping, burn through or discoloring of grain or polish. Welder operates from either 115/230 volt, single phase, 60 cycle a-c, with a power output of 42,000 mfd. *KSM Products Inc.*

Circle No. 33

Increase your hard surfacing productivity . . .

Specify

Wear-O-Matic Wires

in **WELD-PAKS**

The ever increasing work load required of hard surfacing processes, equipment and equipment operators demands greater efficiency of both equipment and operator. The introduction of the Wear-O-Matic wire feed unit utilizing wires in WELD-PAKS has created a new concept in hard surfacing efficiency.

WELD-PAK wires are the key to greater efficiency of both semi-automatic equipment and operator. Each WELD-PAK contains 100 pounds of wire packaged in a "dead cast" resulting in tension free, snarl free feeding. Because the WELD-PAK contains 2 to 4 times more wire than standard coils, the amount of time spent handling wire is lessened, providing more time for welding. There are no cumbersome, springy coils to load or re-tie when unloading the semi-automatic welder. WELD-PAKS are easier to handle and store; and on the job, the lid can be replaced after use assuring dirt and dust free wire when you are ready to resume welding.

Wear-O-Matic 7/64" diameter wires are available in grades to meet most hard surfacing and build-up requirements. They are precision drawn, fabricated wires providing a greater degree of uniformity in chemistry and metallurgy, superior arc stability, no slag cleaning, uniform hardness and uniform wear resistance.

NOW! WELD-PAK EFFICIENCY AND ECONOMY IS AVAILABLE FOR ANY SEMI-AUTOMATIC HARD SURFACING PROCESS

If you are now using semi-automatic hard surfacing equipment, WELD-PAK Wear-O-Matic wires will provide greater operating efficiency than you can now obtain. For details, write stating type of equipment now in use.

If you want maximum efficiency in semi-automatic hard surfacing, inquire about the complete WEAR-O-MATIC process. The Wear-O-Matic wire feed unit is only $279.00 f.o.b. York, Penna. or El Segundo, Calif. Write requesting Bulletin HS-102.

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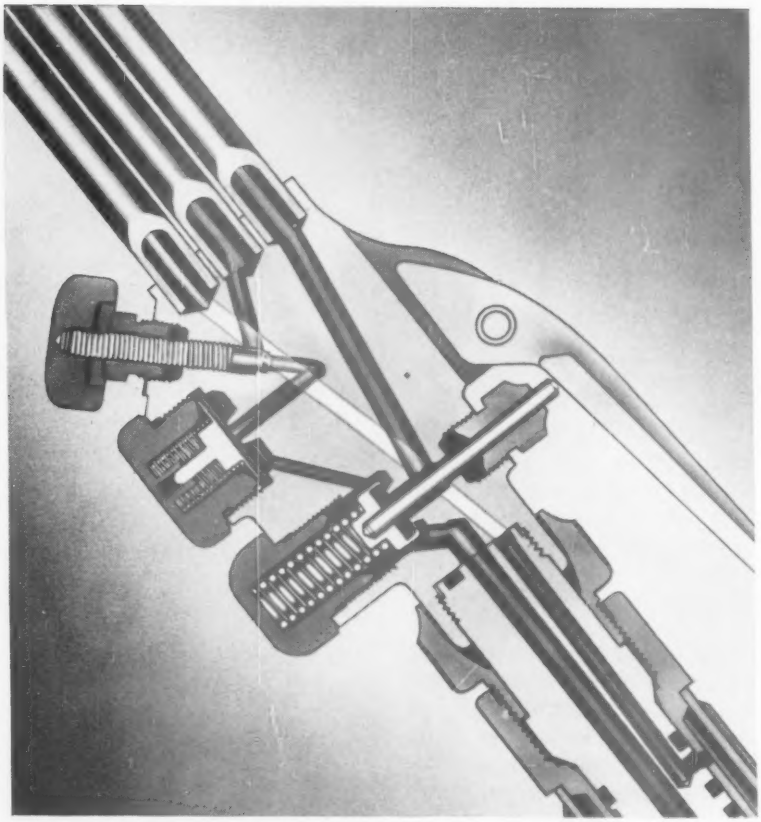
QUALITY WELDING ELECTRODES FOR

Stainless Steel
Low Alloy Steels
Cast Iron
Tool Steel
Bronzes & Dissimilar Metals
Hard Surfacing Electrodes & Wires

Alloy Rods Company

YORK, PENNSYLVANIA • EL SEGUNDO, CALIFORNIA

NO FINER ELECTRODES MADE . . . ANYWHERE



This spring-loaded, diaphragm-type, back pressure check valve greatly reduces the number and effect of backfires. Developed and patented by Smith's, "Flo-Trol" prevents the back flow of oxy-acetylene mixtures. It's exclusive, standard on all Smith's cutting assemblies.

BONUS . . . the World's Best Repair Service when you use Smith's equipment!

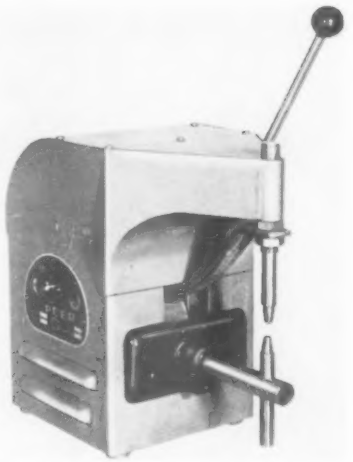
Users' experience has shown that the safety features such as Flo-Trol valves developed in our welding and cutting equipment mean fewer repairs as well as safer working conditions. This low frequency of repairs is the reason we can afford to back our products with the World's Best Repair Service.

Here's how it works: when a piece of your Smith's equipment becomes inoperative, you exchange it for a 100% factory reconditioned piece of the same equipment . . . completely overhauled, with new seats, packing, seal rings, and newly refinished in bright nickel. No matter what the damage to your equipment, your only cost is a low flat-rate repair charge. *And there's no waiting:* you make an on-the-spot exchange at your Smith's distributor. Just bring in your damaged equipment, pick up a like-NEW replacement!

For more information about the World's Best Repair Service covering all major items currently manufactured, *write:*

SMITH'S

Smith Welding Equipment Corporation
2623 Fourth Street S.E., Minneapolis 14, Minn.



Bench welder

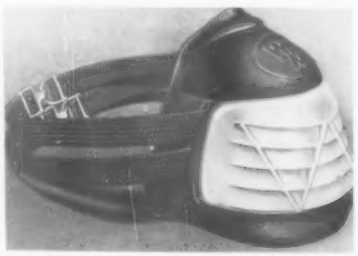
COMPACT Peer Model R-600 1-kva bench welder for light assembly operations is flexible and easy to operate. Hand-operated spot welder is available in 110 or 230-volt capacities, single phase, 60 cycle. It is mounted on rubber feet and operates from an ordinary house lighting circuit. Cam-lever action produces required high pressure to make spot welds on mild or stainless steel through 26 gage, and cross-wire welds though two pieces of 3/12-in. clean steel wire. *Peer Inc.*

Circle No. 34

Thermostat kit

COMPANY has thermostat kit for use with its 1710 LP-gas fired portable blower heater. The 1722 Conversion Kit can be furnished with a 1710 unit from the factory, or unit may be adapted in the field for thermostatic control. Kit provides for "on" and "off" regulation of blower's heat cycle to maintain even temperatures and assure gas economy, says manufacturer. *Insto-Gas Corp.*

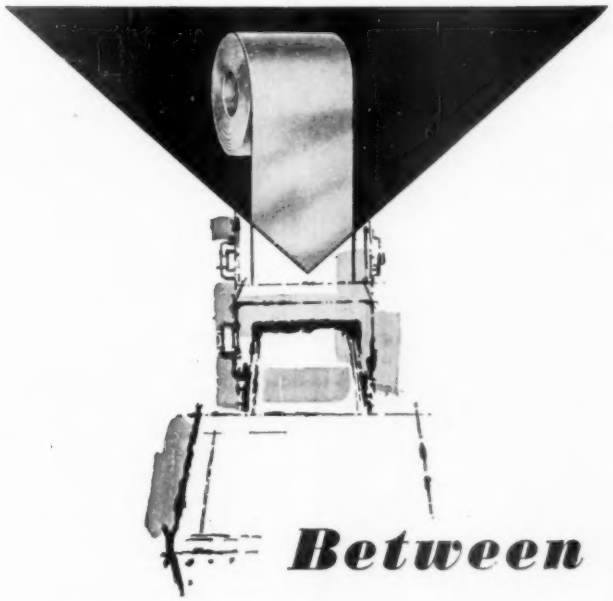
Circle No. 35



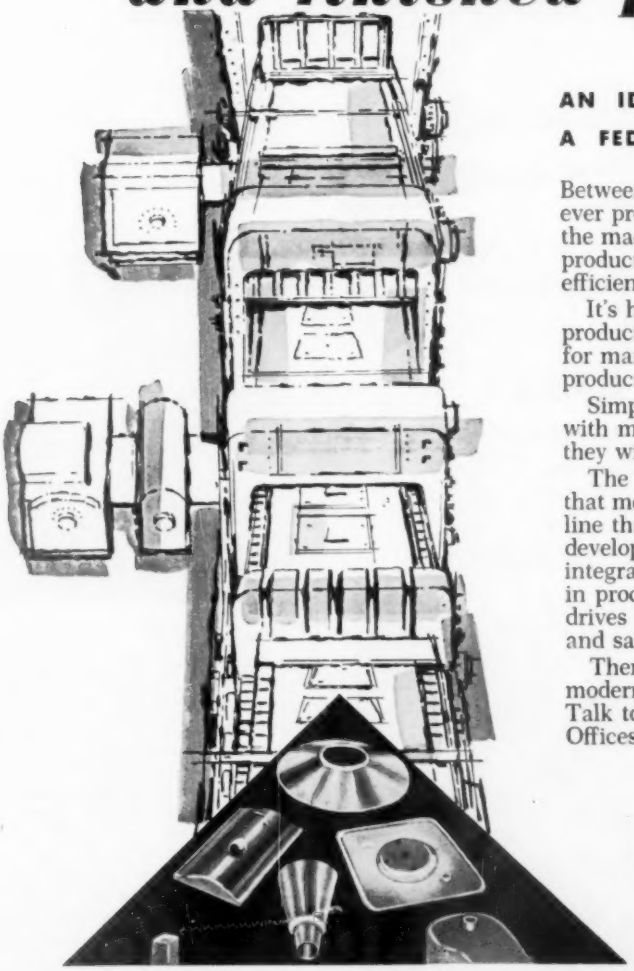
Respirator

PLASTIC respirator for protection against dusts, pneumoconiosis-producing mists and chromic acid mists weighs only 2.1 ounces and has a large filter area which increases filter life. Valve construction and location reduces inhalation and exhalation resistance. Modified polyethylene material is nontoxic, resilient and durable. Filter is a tested, treated-wool electrostatic type. *Welsh Mfg. Co.*

Circle No. 36



Between material and finished part...



AN IDEA THAT MAKES SENSE —
A FEDERAL-WARCO PRODUCTION LINE

Between material and finished part is the ever present problem of bringing together the machinery necessary to perform all production on operations as speedily and efficiently as possible.

It's here, the Federal-Warco, this packaged production line has proved to be the answer for many of the nation's foremost production experts.

Simply provide Federal-Warco engineers with material and part information and they will develop a line to do the job.

The advantages: One source responsibility that means faster, more thorough service; a line that is 100% harmonic, all stations developed especially to work in synchronization; integrated and automated handling of work in process; the possibility of utilizing common drives and bases, reducing operating costs and saving valuable floor space.

There is much more. Why not look into this modern method of production line manufacture? Talk to your Federal-Warco representative. Offices in all leading industrial areas.

Federal / Warco
PACKAGED
PRODUCTION LINES

THE FEDERAL MACHINE AND WELDER COMPANY • WARREN, OHIO

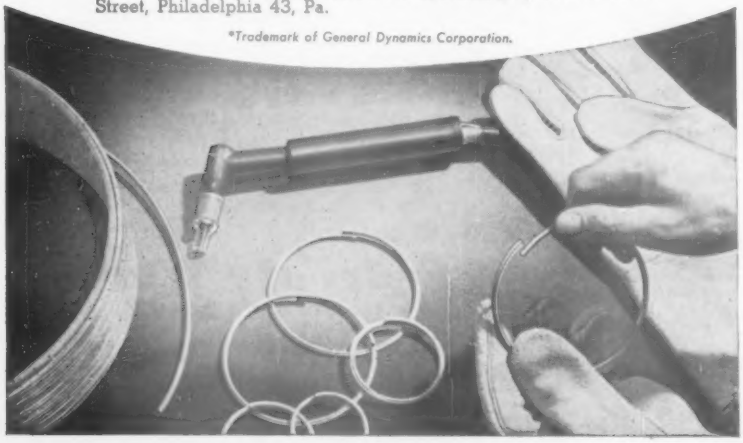
NEW WELDING PROCESS used to fabricate reactor test vessel

Job Report Courtesy of
Newport News Shipbuilding and Dry Dock Company

the ARCOS EB* WELD INSERT

To simplify and speed joining the halves of this pressure vessel shell, and insure corrosion resistant root passes, a preplaced Arcos Consumable Insert was used. With this method, *only outside welding* was required to produce sound welds with uniform contours on the inaccessible inside surface. The welds readily passed Radiograph inspection for freedom from porosity, slag and other inclusions. The EB Weld Insert can save *you* time and money. Write for details. ARCOS CORPORATION, 1500 S. 50th Street, Philadelphia 43, Pa.

*Trademark of General Dynamics Corporation.



Starter set

PUROX W-200 starter set includes a blowpipe with one welding head, a cutting attachment and cutting nozzle, two regulators, Oxweld hose, goggles and friction lighter. Head welds up to ⅛-in. thickness, and nozzle cuts up to 2 in. *Linde Co.*

Circle No. 37

Gas control

GAS CONTROL unit is a push-button device which regulates oxygen and fuel gas flow in hand or machine welding and cutting operations. Manufacturer says unit affords fast starts, reduced gas consumption, improved quality and increased production. H-1050 gas-saving valve can also be used for production brazing and heating, silver soldering, frequent and intermittent welding operations, heat treating or flame hardening. It has a capacity for normal operation of eight machine cutting torches. The unit is solenoid operated and plugs into any 110-volt outlet. *Smith Welding Equipment Corp.*

Circle No. 38

Reactor unit

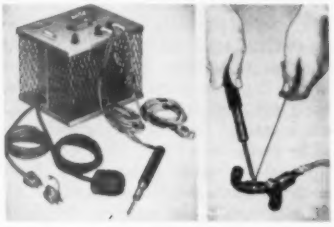
DYNAMIC reactor for carbon dioxide welding is a compact, static, two-terminal package power supply unit. For use with constant-potential, constant-wire-feed welders, reactor limits rate of rise of weld current, permitting use of lower weld currents and transfer of weld metal in droplet form. This means larger and less expensive weld wire can be used, and vertical and overhead welding is possible. Small reactor is rated 150/300 amps, at 100% duty cycle, and is for nominal gage materials. Large unit, rated at 300/600 amps, 100% duty cycle, is best suited for high-speed automatic or high-current semiautomatic applications. *Westinghouse Electric Corp.*

Circle No. 39

Aluminum soldering rod

AIRCO 720 Al-Solder Rod is specifically designed for soldering aluminum. New electrode provides a good color match, is clean to use, requires no flux, washing or wire brushing. Pre- and post-cleaning are unnecessary. Applied by rubbing across heated joints. Melting and wetting takes place at 720 F, 400 to 500 F below the melting point of aluminum. Can join mitered aluminum window or door sections, air ducts, etc. *Air Reduction Sales Co.*

Circle No. 40



Brazing unit

QUICK-heating feature of Thermo-Weld makes it ready for use when it is plugged in. Metal cage cabinet has three output terminals, pilot light and socket for holding work probe. Device can be used for thawing frozen water lines, soldering copper piping for heating and plumbing applications, and rain gutters. Includes a foot switch, three wire a-c line cord and working ground clamp. *Auto-Test Inc.*

Circle No. 41

Galvanizing paint

GALVANIZED surfaces damaged during transportation or erection can be repaired in the field with Galvanox, paint applied with an ordinary brush to 4 to 5 mils thickness. Galvanox contains a high percentage of metallic zinc in an organic binder which forms a zinc film when applied. Adhesion to underlying surface is said to improve with time. Also can be used on welds, and as a sacrificial anode to minimize corrosion between dissimilar metals. *Subox Inc.*

Circle No. 42

Cylinder labels

VINYL plastic pressure sensitive cylinder labels are stripped into position without using water. Labels can be applied to almost any surface and are unaffected by nearly all gaseous and liquid substances. Labels, available in any color, size or shape, can withstand sandblasting once in place. *Prentice Products Co.*

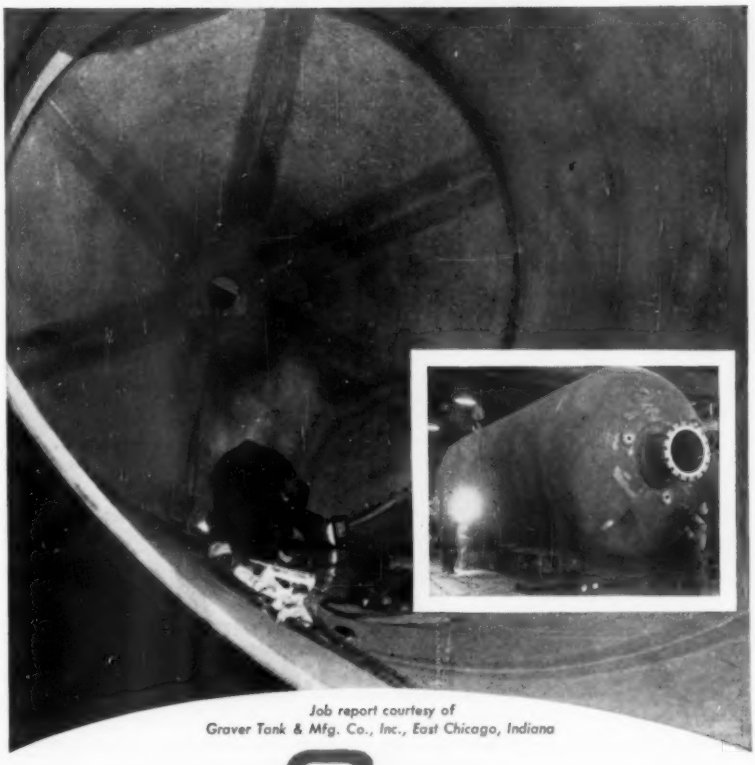
Circle No. 43

Manual valve

COMPANY has new reverse acting, knob controlled, panel mounted manual valve for up to 200 psi pneumatic and hydraulic or vacuum service. Valve is specially suited for emergency control applications where a fast push-type action is needed rather than standard pull-type, says manufacturer. *Valvair Corp.*

Circle No. 44

When stainless welds must be free of microcracks



Job report courtesy of
Grover Tank & Mfg. Co., Inc., East Chicago, Indiana

WELD WITH ARCOS

STAINLESS ELECTRODES

This 93,400-lb. 3500 cu. ft. digester is installed at Finch, Pruyn and Company, Inc., manufacturers of printing and converting papers. It converts hardwood into paper pulp using highly corrosive acids at high temperatures, and pressures of 200 psig. The digester is made of Type 316 ELC 20% stainless clad on ASTM A-212 Grade B firebox steel. To assure sound, long-life corrosion-resistant welds, three grades of Arcos CHROMEND Electrodes were used. All welding was manual. The resultant welds were completely free of micro fissures or cracks—more proof why Arcos weld metal is used so widely to combat destructive and costly corrosion. Write for an Arcos Stainless Application Chart. ARCOS CORPORATION, 1500 South 50th Street, Phila. 43, Pa.

MERRILL MB BROTHERS
MATERIAL HANDLING DEVICES

- Safety Factor—5 to 1
- Factory tested at triple rated capacity.
- Will lift from horizontal or vertical position.
- Cam and Pads of case hardened tool steel.
- All operating parts replaceable when worn.
- Swinging or jerking loads will not affect grip.
- Useful for positioning in welding operations.

The HEAVIER the LOAD • • • the TIGHTER the GRIP! 3-T-17

MERRILL BROTHERS

56-81 ARNOLD AVE., MASPETH, N.Y.

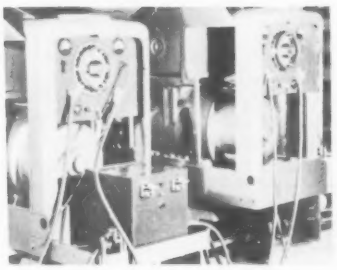
with ALL-STATE special alloy rod
broken · cracked

CAST IRON

can be chamfered · cut · welded in place

Weldors demand All-State's family of electrodes for cast iron repairs • less dismantling • low cost • low heat.

All-State Distributor stocked everywhere! Convenient to buy! Economical to use!
ALL-STATE WELDING ALLOYS CO., INC., White Plains, N.Y.



Paralleling attachment

NEW attachment simplifies the paralleling of two arc-welders for automatic welding, arc cutting, stud welding, etc. Provides protection to weldors in event either machine is improperly set or adjusted. Completely enclosed in a steel case is a magnetic contactor, controlled by a push-button and by protective current relay, with a light to indicate when contactor closes. Should the two welders become unbalanced, current will flow in the equalizer circuit. Attachment will function with any of firm's electric, gasoline or diesel-powered rotating type d-c welder that is rated 60% duty cycle or higher. *Hobart Bros. Co.*

Circle No. 45

Pipe-angle computer

PIPE-angle computer determines angle cut and pipe length required to extend a pipeline parallel to its original direction but at a different height, or to the right or left of original line. Angle of cut and pipe length of "dog leg" can be determined with one move of instrument if offset (height) and space (width) allowed for this transverse distance are known. *Big Midget Products.*

Circle No. 46

Weld deoxidizer

WELDALUMINITE acts as a weld deoxidizer and deporosite. Manufacturer claims it does not have to be removed before weld is made, and actually improves joint quality. Will protect freshly prepared joints and vees for several weeks. Can be applied by brush, spray gun or dipping. *Spekaluminite Co.*

Circle No. 47

Drill presses

THREE new magnetic drill presses are said to simplify precision electric or air drilling in romote or difficult applications. Presses, designed to accommodate any model of portable aid and electric drills equipped with dead handle sockets, can be clamped to any ferrous surface. Model 2 MAG handles ¾-in. capacity electric and 1-in. capacity air drills, Model 3 MAG 1¼-in. electric drills and 1¾-in. air drills, and Model 4 MAG 1¼-in. electric and 2-in. air drills. *Thor Power Tool Co.*

Circle No. 48

Carbon products

COMPANY is now selling a new line of welding carbon products through its retail sales outlets. The line includes a-c welding electrodes, carbon plates, carbon rods and carbon paste. *Arcair Co.*

Circle No. 49

cepted the "distributor-of-the-year" plaque from G. E. Sellstrom, president, at the manufacturer's Palatine, Ill., plant.

Following Mobile in volume of orders taken during the contest were Post Welding Supply Co., Birmingham; Louisiana Welding Supply Co., Baton Rouge; Regis H. Voye, Buffalo; El Cometa, Ponce, Puerto Rico; Speidel Safety Service, Oak Park, Mich.; Mineweld Co., of Indiana, Indianapolis; Calumet Welders Supply Co., Gary, Ind.; Gases y Electrodos, Monterrey, Mex., and Protective Clothing Co., Pittsburgh.

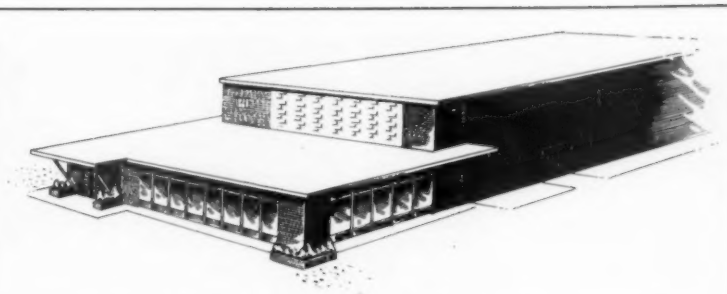
Squirt welding helps Finns cut costs

A Finnish fabricator cut welding costs 55% when he switched from manual electrodes to semiautomatic, submerged arc welding.

The savings were made on the fabrication of feeder-furrows for a woodchipper machine used in paper mill operations. Originally cast, the design was changed so it could be welded, reducing manufacturing costs by 30%.

At first, operators at the Ahlstrom Osakeyhito plant at Karhula used manual coated electrodes and spent 45 hours welding each part. Welding time was cut to 20 hours when they switched to Lincoln Electric's Manual Lincolnweld ML-2 equipment.

Joints welded are from one to 12 ft long, using one or more passes. All welds are manually guided, using currents between 475 and 600 amps.



NEW facility of Earlbeck & Landrum Inc., Baltimore welding equipment and supplies distributor. An all-welded structural steel front holds 70 ft of glass panels. Building's metal acoustical pan ceiling conceals lighting, air conditioning and heating equipment. Parking lot, covering 35,000 sq ft, offers firm room for future expansion.

Earlbeck & Landrum occupy new quarters

Earlbeck & Landrum Inc., Baltimore welding equipment and supplies distributors, have moved into a new building at 2401 Pulaski Highway.

The building is of welded-steel, brick and 12-in. concrete block construction. It has a 7,000 sq ft selling area, a warehouse, shop and 35,000 sq ft parking lot. Almost half the building is centrally heated and air-conditioned.

The facility has 70 ft of glass panels in a structural steel front. Display room and offices have a metal acoustical pan ceiling, arc-welded to the steel front, that conceals lighting, heating and air-conditioning equipment. The front and metal ceiling are of all-welded construction.

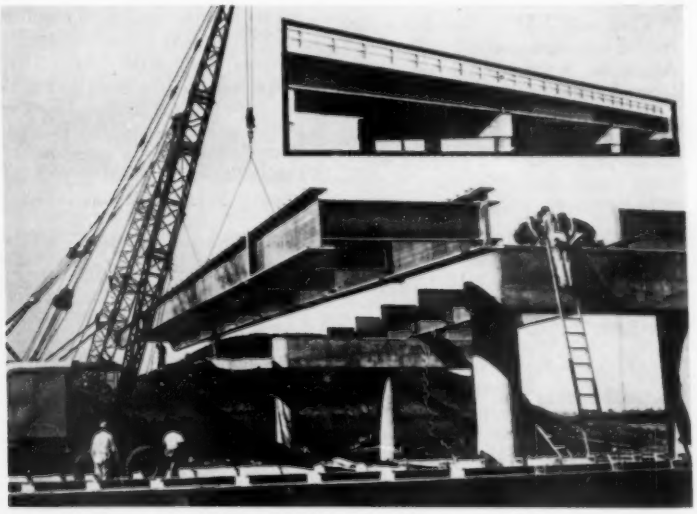
Machine design competition offers $50,000 in awards

The James F. Lincoln Arc Welding Foundation, Cleveland, is offering 54 cash awards totaling $50,000 for papers describing the use and advantages of arc-welding in the design and construction of machines or components.

The top award is $10,000. Papers may describe how a machine is improved or reduced in cost through redesigning a casting to a weldment, redesigning an existing weldment or designing a new weldment. Weldments used in practically every type of industrial machinery are eligible.

Rules for the competition are contained in a booklet obtainable from the Foundation, Box 3035, Cleveland 17, O.

SQUIRT welding being done on feeder-furrows for woodchipping machines by Finnish fabricator at Osakeyhito plant, Finland. Cocked cone seen in picture was originally made for welding curved-vane motors for a vacuum pump.



A giant subassembly of aluminum structural members is placed during construction of first aluminum girder type highway bridge in world. Field erection was simplified by prefabrication of lightweight members. Section of completed bridge near Des Moines, Ia., is shown in inset. (See WE, August, p. 54.) Bridge was recently dedicated.

Shield them with economical barriers of J-M ALUMINIZED Asbestos Cloth

Radiant heat is a major cause of discomfort and fatigue that reduces efficiency and causes accidents. Economical new J-M *Aluminized* Asbestos Cloth reflects 90% of all radiant heat . . . helps maintain high production and good safety practices.

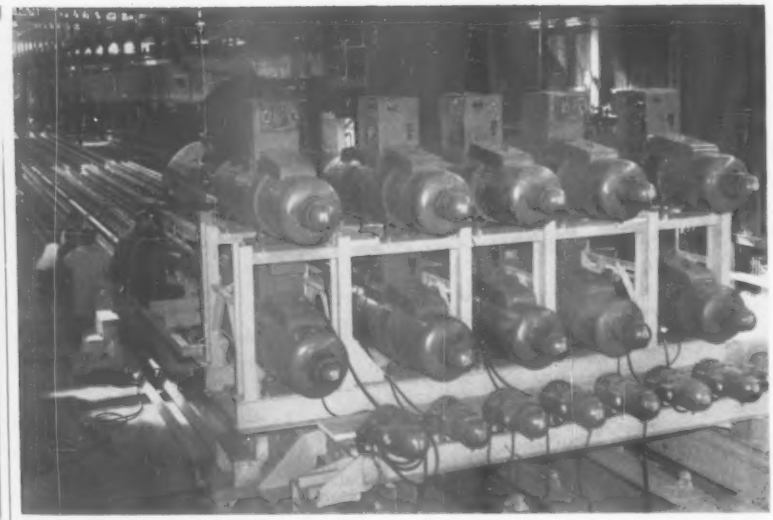
This new J-M material is a rigidly tested combination of aluminum and Asbestos. It retains a great degree of strength at temperatures up to 1400°F —over long periods of time—and can be used for curtains, shields, blankets, hoods and covers to protect workers from flame as well as radiant heat.

For further data, write Johns-Manville, Box 14, New York 16, N. Y. Ask for Brochure TX-2A.

PORTABLE SHIELDS for emergency jobs near heat or flame can also be made with this J-M *Aluminized* Asbestos Cloth.

JM JOHNS-MANVILLE

100 YEARS OF QUALITY PRODUCTS . . . 1858—1958



PULLMAN-Standard Car Mfg. Co. has designed and built what is said to be largest submerged-arc welding installation ever developed for a single welding operation. Machine is at company's Butler, Pa., freight car plant and is for mass-producing 85-ft flat cars for railroad piggy-back service. Welding unit, with its 385 ft jig, uses 20 welding heads which can simultaneously make ten 85-ft welds. Each car needs 3,000 ft of welding.

Safety Congress attracts 12,000

The recently held National Safety Congress, sponsored by the National Safety Council, Chicago, attracted 12,000 registrants from all parts of the country. The exhibition room in the Hilton Hotel had 284 displays of safety and related equipment.

Among those who had displays were American Optical Co.; Chicago Eye Shield Co.; Dockson Corp.; Fibre-Metal Products Co.; Glendale Optical Co.; Insto-Gas Corp.; Jackson Products, Air Reduction Sales Co.; McKay Co.; Riegel Textile Corp., Industrial Glove Div.; Sellstrom Mfg. Co. and Welsh Mfg. Co.

Also shown at the Congress were the safety booklets published by the Council. One such book, "Easy does it," tells workmen how to lift heavy objects without injuring themselves. Descriptive literature about the booklets and information on quantity prices may be obtained from the Council, 425 N. Michigan Ave., Chicago.

Robinson Supply holds welding show

Robinson Welding Supply Co., Detroit, recently held a welding show attended by more than 100 persons, representing 41 industrial concerns in the Detroit area.

Exhibits were contributed by Linde Co., Lincoln Electric Co., Miller Electric Mfg. Co. and Worthington Corp.

Demonstrations were put on by Alloy Rods Co., Arcair Co., Aro Spot Welder Div. of Guthery Machine Tool Corp., Linde Co., Vacu-Blast Co., Inc. and Bernard Welding Equipment Co.

SECTIONS of tantalum liner for 30-gallon reactor vessel are welded inside this vacuum "dry box." Work area is cleared, then backfilled with inert gas so that welding is done in a contamination-free atmosphere. Operator works in chamber using rubber gloves extending through side walls. Pfaudler Co., Rochester, N. Y., designed and fabricated the vessel using tantalum liner supplied by Haynes Stellite Co., Kokomo.

Penn State expanding welding shop courses

Pennsylvania State University, University Park, is building a new engineering building that will house an 1,800 sq ft metal joining laboratory. The new building and laboratory are part of the University's program to expand the number and scope of its manufacturing process type courses.

At present, welding courses are conducted in a 675 sq ft sector of the forming, heat treating and joining laboratory. Gas and metal-arc welding are taught.

To widen the courses' scope, the industrial engineering department has added a 50 kva spot welder, two a-c welding machines with high frequency for Tig welding and a stud welder.

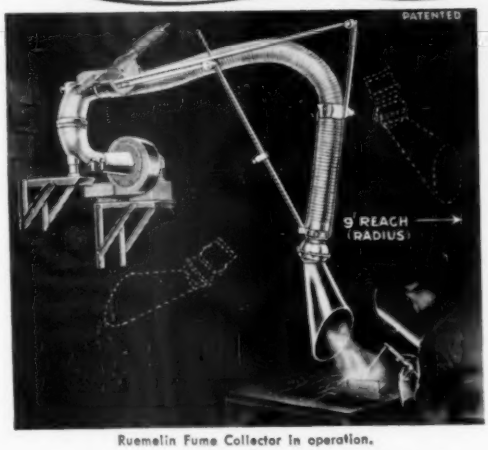
Equipment to be purchased in the future includes a welding head manipulator, an automatic welding head for Mig, CO_2 and submerged arc welding, a 600 amp constant potential rectifier welder, semiautomatic welder for Mig, CO_2, plug and tack welding and a Detroit tensile testing machine for use with a spot welder, and other pieces.

The new equipment will enable instruction to be given in manual, semiautomatic, automatic and resistance welding, as well as gas and metal-arc welding already offered.

A research and testing laboratory will also be housed by the new building, to be completed in 1960. This will make it possible to study effects of various manufacturing processes on materials. The laboratory may also make it possible to offer advanced courses in metals joining.

EARLY this year the Young Men's Christian Association of Ethiopia began teaching local young men welding. Merlin A. Bishop, general secretary and American representative to the Ethiopian YMCA, instructs students in fundamentals of maintenance and light production arc-welding, using a Lincoln a-c/d-c 180 amp welder.

"It certainly is a relief to have fumes and heat removed while I'm welding. The Ruemelin Collector has great suction. It makes a day's work pleasanter!"



Ruemelin Fume Collector in operation.

Welding shops equipped with Ruemelin Fume Collectors are assured of a clean shop atmosphere. Noxious fumes, heat and smoke are eliminated at their source, thus improving working conditions, lessening fatigue and paving the way for increased plant production.

The Ruemelin Fume Collector hood can be instantly placed where needed anywhere in the booth welding area. No tedious adjustments necessary. Just pull the inlet hood to the welding position and you are ready to go.

Note the new spring-loaded counterbalance mechanism which makes Fume Collector much easier to handle. Ask for Bulletin 37-E illustrating this new feature.

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SAND BLAST AND DUST COLLECTING EQUIPMENT
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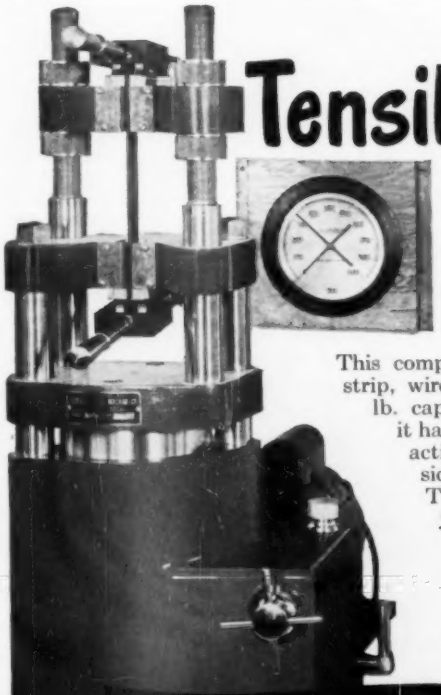

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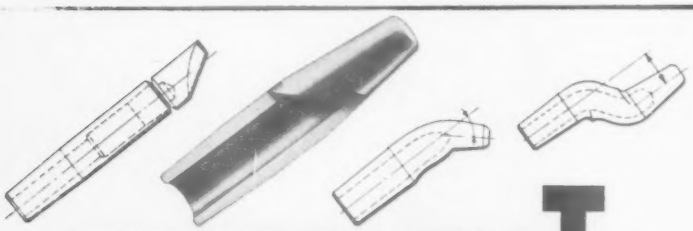

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Ask for Catalog and Price List.

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A Division of Air Reduction Co., Inc.
150 East 42nd Street, New York 17, N.Y.

KLEMP Metal Grating Corp., Chicago, has its own machine for production, an automatic welder for producing metal grating. Basis of machine is Verson gib-guided 125-ton hydraulically operated press equipped with four resistance welding transformers totaling 1,200 kva. Several eight point heat regulators control welding heat and an indexing unit provides positive spacing of crossbars. Machine produces 3,500 sq ft of grating in eight hours.

ASME convention in New York, Dec. 1 to 5

The 1958 American Society of Mechanical Engineers meeting will be held at the Hotels Statler-Hilton and Sheraton-McAlpin, Dec. 1-5, in New York City.

"New frontiers in engineering—key to mankind's progress," is the theme of the meet that will include 140 technical sessions and reports by more than 400 authors.

Coyne Cylinder opens midwest division

Coyne Cylinder Co., San Francisco, has opened a midwestern division office at 3800 Springdale Ave., Glenview, Ill. The company has other division offices in Newark and Memphis.

Raymond A. Harder is manager of the new office. Formerly of the southern office, Harder was at one time head of the firm's accounting department and has six years' experience in administrative procedure, cylinder control and the manufacture and distribution of compressed gases.

COMING EVENTS

DEC. 4: NWSA Southwestern Zone Meeting, The Statler Hilton, Dallas, Tex.

DEC. 4: NEMA Arc welding Section Quarterly Meeting, Chicago.

JAN. 8-10, 1959: NOIMA Trade Show and Exhibit, Atlanta Biltmore Hotel, Atlanta, Ga.

JAN. 26-29: Plant Maintenance and Engineering Show, Cleveland Public Auditorium, Cleveland.

JAN. 28-29: Midwest Welding Conference, Illinois Institute of Technology, Chicago.

MARCH 12, 1959: NEMA Arc Welding Section Quarterly Meeting, Pittsburgh.

MARCH 16-20, 1959: ASM Western Metal Exposition and Congress, Pan-Pacific Auditorium and Ambassador Hotel, Los Angeles.

APRIL 7-10: 1959 AWS Welding Show, International Amphitheater, Chicago, Ill.

JUNE 4-5, 1959: NEMA Arc Welding Section Quarterly Meeting, Hot Springs, Va.

Pipeline News

Transcontinental Gas Pipe Line Corp., Houston, Tex., has FPC authorization to expand its natural gas transmission system at a cost of $167,000,000. The expansion includes construction of storage fields in northern Pennsylvania.

FPC permission has been given El Paso Natural Gas Co., El Paso, Tex., to construct and operate an additional 20,400 horsepower and dehydration capacity at its Aneth Field compressor station.

Linde to produce oxygen for Armco

Linde Co., New York City, will build and operate a 130-ton a day oxygen plant for the Middletown, Ohio, works of Armco Steel Corp., on property leased from Armco.

All oxygen will be high purity gas piped to various locations at the Armco works. Some of the oxygen will be used to enrich the air of open-hearth furnaces.

Distributor appointments

Glendale Optical Co., Valley Stream, N. Y.; Fibre-Metal Midwest Inc., Bridgeview, Ill.

C. B. Herrick Mfg. Co., Cleveland; Airline Welding and Engineering Co., Hawthorne, Calif.

Olin Aluminum, Div. of Olin Mathieson Chemical Corp., New York City; Kelco Metal Products Co., Boston; Guardian Aluminum Sales Inc., Chicago.

Ampco Metal Inc., Milwaukee; A. E. Dailey Co., Moline, Ill.

Miller Electric Mfg. Co., Appleton, Wis.; Industrial Welding Supply Co., Pensacola, Fla.; Universal Welding Supply, New Lenox, Ill.

Arcair Torch
SAVES $6000
for Lift Truck Maker

Confronted with a design change on 20 cast iron lift truck counterweights worth $300 each, the Automatic Transportation Co. of Chicago turned to Arcair for low-cost metal removal.

An earlier attempt to clean out an area 4"x 3"x 30" by means of drilling and oxy-acetylene cutting took a total of 24 hours and resulted in expensive drill bit breakage. At that point, it was decided to try the Arcair process . . . The result? — A Model H-3 Torch did the complete job in just 6 hours per casting at a cost of only $11.92 for the 100 "Copperclad" electrodes consumed.

Arcair can help you too! Basic simplicity — electric arc plus ordinary compressed air — makes the patented Arcair torch, with Arcair "Copperclad" Electrodes, the new, efficient, cost-cutting answer to most metal removing problems.

Get more information from Arcair today!

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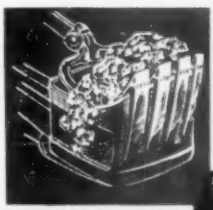

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About people . . .

Burke

Tietz

Zitzmann

Honan

Two newly created posts have been filled by Handy & Harman Co., New York City. *E. Earle Tietz* has been appointed manager of marketing services assuming responsibility for advertising, brazing and arts products, industrial products, sales training and service. *Robert E. Burke* is field sales manager in charge of the company's field sales organization. Replacing Burke as New York district sales manager is *Clark P. Zitzmann*. *William K. Honan* replaces Tietz as industrial products manager.

Robert A. Hamen has been appointed factory sales representative for Selltrom Mfg. Co., Palatine, Ill., manufacturers of safety equipment. From his headquarters in Pittsburgh, Hamen will cover Michigan, Ohio, western New York, Pennsylvania and part of West Virginia.

Bay State Abrasive Products Co., Westboro, Mass., has appointed *Dr. H. Nathan Stone* director of research and development. He replaces the retired *Albert L. Ball*.

Air Reduction Co., Inc., New York City, has named *R. H. Merriman* manager of the company's Buffalo district, succeeding *H. J. Schlieder*. *F. C. Millspaugh, Jr.*, replaces Merriman as assistant manager-sales, in the Jersey City office.

Lincoln Electric Co., Cleveland, has added the following sales engineers to its district office organizations: *David E. Reader*, Albany, N. Y., *Richard T. Schneider*, Cleveland; *Harold W. Leavens*, Los Angeles; *Ronald Bauer* and *Harrison A. Smitson*, Pittsburgh, and *David Nicholas*, Toledo. Meanwhile, *David L. Stocks*, sales engineer, has moved from Los Angeles to Fresno, Calif. *Daniel E. Doudna*, sales engineer, has moved from Chicago to Rockford, Ill.

Paul W. Chatterton is director of the welding and safety department of J. E. Haseltine & Co., Portland, Ore. *John Wehlitz* has been added to the department. The company's reorganization program has brought about several other changes. *Harry Crowston* now covers the Pendleton territory and *Don Sharpe* covers the Eugene territory vacated by *Earl Chamberlain*, new field sales supervisor. *George Madison* is covering the Salem territory, *Ron Monda* is working in Southwest Washington. *Len Younce* on the West Coast and *Bill Kalibak* in Medford. The suburban territory of Portland and Vancouver is covered by *Dan Pendergrass* and *Dwight Nunamaker* has been added to the Portland territory. *Jack Frezza* is working in the steel department and his Yakima territory is being covered by *Fred Simmons*.

Ralph C. Schiring has been elected president of Picker-X-Ray Corp.'s Waite Mfg. Div., Cleveland. He is a graduate of Case Institute of Technology and has been with the company since 1931. He succeeds *Edwin C. Goldfield*, who has retired.

Leo I. Dana has been appointed vice president—technology and *David Swan* vice president—research for Linde Co., New York City. Dana will headquarter in Tonawanda, N. Y., and Swan in Speedway, Ind. Dana directed work that resulted in a safe method of distributing liquefied oxygen and nitrogen. Swan was responsible for development of Unionarc and Sigma welding methods and for finding new processes of making high temperature alloys.

Ellis H. Born is the new director of sales engineering for Denison Engineering Div., American Brake Shoe Co., Columbus, O. He will be concerned with the technical aspects of all sales department activities.

Ernest E. Michaels has been elected to a three-year term as chairman of the Welding Research Council of the Engineering Foundation. Michaels is president and a director of Chicago Bridge & Iron Co., Chicago.

Michaels

Scott

Nuclear Systems Div. of Budd Co., Philadelphia, will be supervised by *Philip W. Scott*, recently elected group vice president. Three wholly owned subsidiaries will also be under Scott's supervision. He was administrative vice president of Byron Jackson Div., Borg-Warner Corp.

Died . . .

Thomas A. Hickey, 48, died recently in Fort Wayne, Ind., while on an extended business trip. At his passing, Mr. Hickey was sales manager of K-G Equipment Co., Allentown, Pa. He had been with K-G since 1956. Previously he was with Liquid Carbonic Corp., now a division of General Dynamics Corp.

Paul B. Pew, 60, executive vice president, Linde Co., New York City, died recently.

Former manager of Automotive development for Climax Molybdenum Co., Div. of American Metal Climax Inc., *V. A. Crosby*, is dead. Mr. Crosby was a vice president of the Society of Automotive Engineers Inc., a member of the Engineering Society of Detroit, and in 1951 was recipient of the American Foundrymen's Society John A. Penton Gold Medal.

Merrill Burnidge, 59, head of Burnidge Oxygen Distributing Co., Kansas City, died recently of a heart attack suffered while hunting. Mr. Burnidge was president of his local Chamber of Commerce and chairman of the board of the North Kansas City Hospital.

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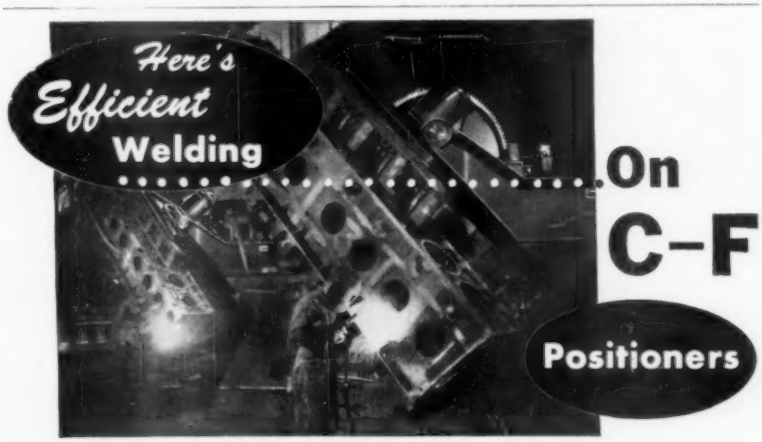

When heavy, unwieldly weldments like these diesel crankcases can be quickly swung into any position so that every weld is made *downhand* —that's efficient welding!

Welders spend more time welding—do better welding at lower cost when they work with C-F Positioners because these hand and/or power operated machines reduce positioning time to a minimum. Investigate the cost-saving advantages of C-F Positioners. They pay their way in any company.

Write for Bulletin WP26—an illustrated circular detailing the Specific advantages of C-F Positioners.

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Publishing costs have skyrocketed during recent years—to such an extent that it is no longer possible to continue the prevailing bargain subscription rates for WELDING ENGINEER.

In view of this, rates for the two and three-year subscriptions (which have been in effect for many years) will come to an end on Feb. 28, 1959.

Until then, new and renewal subscriptions will be accepted at the current rates of 2 years for $4 or 3 years for $5. After March 1, 1959, subscription prices for, WELDING ENGINEER the world's pioneer welding publication, will be:

1 Year — $3

2 Years — $5

3 Years — $7

Get your order in now and save. Use the subscription card in this issue. WELDING ENGINEER would make a nice Christmas Gift. Send your order to:

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Morton Grove, Illinois

Welding conference

CONFERENCE ON WELDING ENGINEERING. Edited by Allan L. Tarr. Published by Office of Technical Services, United States Department of Commerce, Washington, 1958. Paper, 8 by 10½ in., 162 pages. Price, $6.00.

This volume is a report of the 1957 conference on welding engineering sponsored by the Corps of Engineers, U. S. Army Research and Development Laboratories, Fort Belvoir, Va.

The volume's material was taken from papers and reports or derived from tape recordings of talks and discussions on the 35 subjects presented during the meeting.

Conference speakers, representing the outstanding welding authorities of the United States and Canada, covered a variety of subjects ranging from "development of welding for engineering fabrication" to "non-destructive testing procedures." Welding codes and standards along with safety procedures were discussed, and papers on design and construction of pressure vessels, bridges, ships, hydraulic structures and building frames were given.

Other papers covered surfacing, hardfacing, evaluation of laboratory fatigue studies, new concepts in welded design, failures of various types and problems in design fabrication testing and inspection of welded materials.

Copper standards

ASTM STANDARDS ON COPPER AND COPPER ALLOYS. Published by the American Society for Testing Materials, Philadelphia 3, Pa., Sept., 1957. 6 by 9 in., 688 pages. Price, paper cover, $6.25, cloth cover, $7.

New edition of the special ASTM standards covering copper and copper alloys, cast and wrought, includes for the first time specifications for threading copper pipe and for copper drainage tube. Products covered are: basic coppers, non-ferrous metals used in manufacture of copper alloys, copper and copper wrought products, copper alloy ingots and castings and copper and copper alloy filler metal. Test methods accompany specifications. A 16-page index is included.

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Patent procedures

IDEAS, INVENTIONS AND PATENTS. By Robert A. Buckles. Published by John Wylie and Sons, Inc., New York, 1957. Cloth, 6 by 9 in., 270 pages. Price, $5.95.

Anyone who has an invention he feels should be patented, or any ideas of ever trying to obtain a patent, will find this book an immense help. Never before has there been so much information on patents, and the problems involved in obtaining them, in a single volume.

The author, through illustrative examples, has pointed out some of the facts considered most important to proper patent and trademark protection. Particular emphasis is placed on how these facts may be recognized, evaluated and employed most effectively in the protection and utilization of such industrial property rights.

Chapters such as "How to plan a patent program," "How to keep records for patent protection," "What is the role of a patent attorney," and "What happens in the patent office," are valuable.

Other chapters are headed "Interference, what it is, how it comes about and what is required to win," "Licenses, assignments and shop rights," "How to read and understand patent claims and recognize infringements," and "Confidential disclosure of trade secrets and unfair competition."

Graphic illustrations of various concepts are employed wherever feasible and a glossary of frequently encountered "patent jargon" is provided. A bibliography is appended for the reference of those who may wish to pursue further any particular facet of the subject discussed. Sample forms of employee contracts, assignments and formal papers are included.

Welding of castings

RECOMMENDED PRACTICE FOR THE WELDING OF STEEL CASTINGS. Battelle Memorial Institute. Published by Steel Founders' Society of America, Cleveland 13, Ohio, 1957. $0.50.

This manual covers developments in welding procedure since 1951 and features a listing of the American Welding Society's classified mild steel and low alloy electrodes. In three sections, the manual covers welding methods, electrodes and recommended procedures for carbon steel and low alloy castings with each general alloy series indexed for quick reference. Manual is a guide to producers and users of steel castings who make use of cast-weld technique.

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FUSE-WELL No. 11, *Square*—Gray Cast Iron Welding Rod for Acetylene use in filling or building up new or worn castings producing machineable welds.

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FUSE-WELL No. 12, *Round*—Has the same uses and analytical ingredients as Fuse-Well No. 11.

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FUSE-WELL No. 14, *Moly*—An Iron Base Rod with alloys added for finer grain structure and greater strength.

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FUSE-WELL No. 22, *Electrode* — Light coated Rod to be used for AC or DC welding in the fabricating and repairing of cast iron castings.

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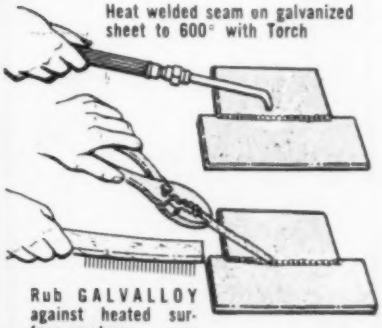
Does - *HERE'S PROOF*

Heat welded seam on galvanized sheet to 600° with Torch



Rub GALVALLOY against heated surface as shown — now spread with wire brush for a bright finish.

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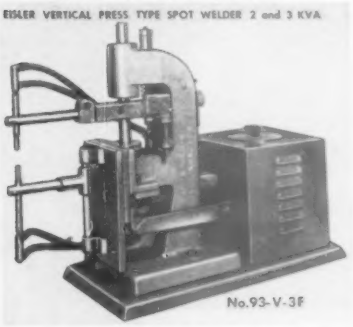

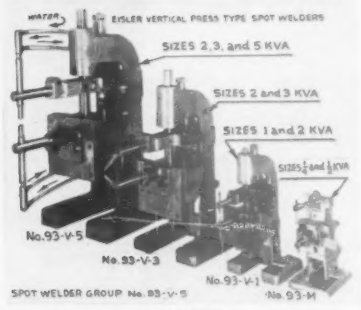

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Ornamental Iron Finish—a plastic-base paint especially developed for painting ornamental metal work. Costs no more than ordinary metal paints. Money-back guarantee. Colors: Gloss Black, Satin Black, White, Primrose Yellow, Natural Gray, Warm Gray, Green.

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The second edition of this text on manual arc welding includes new procedures, information on machines and electrodes and modern teaching methods. Based on arc welding courses taught at the Lincoln school, it is a practical text for teaching. The book is divided into seven sections. Section I deals with specific instructions on arc welding techniques, the next five pertain to the proper use of welding machines and electrodes and a final section is devoted to reference material on metals, procedures, testing and weld symbols.

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BUILDINGS FOR RESEARCH. By the Editors of *Architectural Record*. Published by F. W. Dodge Corp., New York, 1958. Cloth, 8¾ by 11⅝ in., 232 pages. Price, $9.50.

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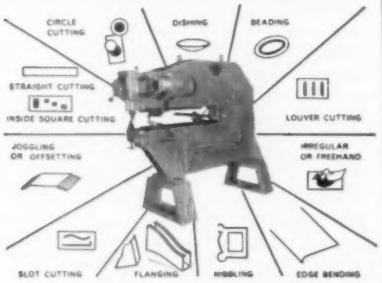

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30 YEARS AGO

(Taken from the *Welding Engineer* of December, 1928.)

—30 YEARS AGO—

Article tells of the evolution of equipment and procedures for water line welding. J. S. Beall, interviewed for the article, cited the Bellingham, Wash., municipal water system as one of the first applications of welding to water line manufacture.

—30 YEARS AGO—

J. F. Lincoln, vice president of the Lincoln Electric Co., Cleveland, gave a paper, "The effects of arc welding on manufacturing," at the semiannual convention of the American Gear Manufacturer's Association in Buffalo, N. Y.

—30 YEARS AGO—

Budd Co., Philadelphia, is promoting good welding by issuing instruction booklets on the proper welding procedures for various jobs.

—30 YEARS AGO—

The use of acetylene for emergency cutting, welding and lighting to help minimize destruction when the St. Francis Dam broke in California, is told in an article by J. B. Ross.

—30 YEARS AGO—

Bain-Beaird Co., Shreveport, La., has changed its name to the Beaird Corp. The new corporation has moved its offices to its general plant at Atkins Ave. at Cedar Grove Rd. in Shreveport.

—30 YEARS AGO—

"Making the oil men like it" is an article by W. F. Stoody and S. M. Stoody of the Stoody Co., Whittier, Calif., telling how the company developed hardfacing techniques for oil well rotary drill bits.

—30 YEARS AGO—

The reasons for welding and methods used in welding roofs and bottoms of steel storage tanks are explained in an article. Tanks described in article have a 125,000 barrel capacity, are 125 ft in diameter and 42 ft high.

—30 YEARS AGO—

John J. Crowe, Air Reduction Co., Jersey City, N. J., is lecturing at Temple University, Philadelphia, in connection with a course on the heat treatment and metallography of steel.

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51. IRON MELTING—National Cylinder Gas Div. Controlled cupola chemistry process is described in information report No. 13. New method of using oxygen as production tool in cupola melting of iron is said to offer good metal temperature control and economy.

52. SHAFT GRINDERS—Stow Mfg. Co. Catalog 57 describes company's flexible shaft machines said to be ideal for grinding welds. Includes specifications and pictures.

53. WELDING EQUIPMENT—Raytheon Mfg. Corp. Bulletin 2-100 details welding heads, controls, power supplies and welding accessories offered by firm.

54. GUIDANCE ATTACHMENTS—Heath Engineering Co. Model CA-30 Circle Guiding Attachment is described and diagrammed in form 52.

55. TANK PRODUCTION SYSTEM—Cayuga Machine & Fabricating Co., Inc. Booklet shows work flow for production of hot water tanks. Company's equipment is used throughout. Pictures and specifications given in catalog 800.

56. TRACTOR PIN PRESS—Lempco Automotive Inc. Six-page folder points out ways to lower costs in servicing crawler tracks through use of Powermatic pin and bushing press.

57. MOLDS AND BASES—Columbia Engineering Co., Inc. Company has catalog and price chart for its standard and special nested plastic molds and die bases.

58. CUT-OFF SAWS—Wallace Supplies Mfg. Co. Pocket-size, illustrated booklet contains information on firm's line of cut-off saws.

59. X-RAY SYSTEM—General Electric Co. TVX X-ray intensification system is described in flyer 7B-3799. Includes pictures and advantages of system.

60. METALLIZING MACHINE—Metco. Bulletin 135-10M-11-57 features electronic control, electric drive metallizing machine for production, production salvage and heavy maintenance work.

61. CRANE CONTROL—Cleveland Crane & Engineering Co. Aluminum inverted-Y conductor systems covering crane and runway electrification are described in booklet 1.

62. BENDING ROLLS—Niagara Machine & Tool Works. Supplement to bulletin 77E illustrates 9 and 10-in. diameter plate bending rolls with finger-tip control.

63. HARDFACING—Wall Colmonoy Co. Vol. 3, No. 3 of *Alloy News* includes article on hardfacing protection for foundry sand screws.

64. SLING CHAINS—American Chain & Cable Co., Inc. Safety and strength factors of Accoloy Kuplex Sling Chains are described in bulletin DH-39.

65. OFFHAND POLISHING—Behr-Manning Co. Pictures tell story of how better offhand polishing can be accomplished with coated abrasive belts.

66. GRINDING—Grinding & Polishing Machinery Corp. Brochure 104 describes G&P 6-72 belt unit for grinding and polishing. Includes specifications.

67. RUBBER EXPANDER—Chicago Rubber Co., Inc. Diameters and their recommended speeds for Cosmo expanders for abrasive sleeves are given in new catalog insert.

68. PAINT STRIPPING—Oakite Products Inc. Four methods commonly used to remove paint are fully described in new booklet.

69. WORK GLOVES—Granet Corp. Six coated safety work gloves for various purposes are shown in catalog.

70. FLUX APPLICATION — Eutectic Welding Alloys Corp. "Complete flux issue" explains the three jobs of flux, and why it must be formulated as a companion to the alloy being joined.

71. TIG WELDER—Hobart Bros. Co. Folder DM-71 describes combination a-c/d-c and Tig welding machine.

72. INSULATOR—Duramic Products Inc. Sur-Braze grade 120-F ceramic for electrical and chemical insulators, brazing and heat treating jigs for use at 2,000 F is described in bulletin 107.

73. X-RAY APPARATUS—Mitchell Radiation Products Corp. Sheet describes Isovolt 150 containing a hollow anode tube suited for radiographic examination of welds in pressure vessels.

74. BOILER TUBES—Babcock & Wilcox Co. Technical data card 157-A gives maximum allowable working pressures for boiler tubes of resistance welded carbon steel.

75. ABRASIVE HEADS—Abrasive Machinery Corp. Smooth-O-Matic contour abrasive heads designed to use paper or cloth-coated abrasives are pictured in sheet giving their advantages and specifications.

76. TIG WELDING—Linde Co. F-50095 describes company's Tig cutting method and equipment.

77. WELDING AND CUTTING—National Cylinder Gas Div. Specifications and pictures are given in booklet covering Torchweld line of welding and cutting apparatus.

78. RELAYS—Automatic Switch Co. Catalog 57-S4 gives data on relays for circuit or load control.

79. ULTRASONIC DRILL—International Electronic Corp. Ultrasonic drill and generator is shown in brochure. Shapes drill is capable of making are pictured and specifications given.

80. TANGENT BENDING—Taylor-Winfield Corp. Bulletin 13-093 gives applications of single wing, duplex and quadruplex air operated tangent bending machines.

81. WELDING SCREEN—Frommelt Industries. Folder 400 describes safety items including Porto welding screen.

82. WELDERS—Sciaky Bros. Inc. Type SP 2 spot welder and Type EP 2 projection welder is described in bulletin 317-2R. Complete specifications and pictures of these air-operated press type welders are included.

83. STAINLESS STEEL CLEANER—Nu-Steel Co. Cleaners and polishes for stainless steels and monel are described in bulletin 30. Includes "dos and don'ts" in care of stainless or monel products.

84. FIRE EXTINGUISHERS—Miller-Peerless. Complete specifications and pictures of extinguishers and safety cans are included on sheet.

85. SPOT WELDING—Aro Spot Welder Div. Booklet covers spot welding guns, lists and pictures various models.

86. WELDING WIRE GUIDE—Air Reduction Sales Co. Pocket guide can quickly answer any question about company's gas-shielded metal arc welding process. Includes wire types, diameters, composition and operating procedures.

87. ARC WELDING TITANIUM — Mallory-Sharon. Bulletin 5M-4/58 lists those titanium and titanium alloy materials that are suited for arc welding and will not become embrittled by the process. Other facts pertinent to the subject are included.

88. FLAME-CUTTING—Jos. T. Ryerson & Son, Inc. Revised bulletin 50-1 gives latest information on circles, rings, and shapes flame-cut from steel plate of any thickness.

89. ARC WELDING CIRCUITS—Lenco Inc. Booklet gives detailed account on how one can reduce costs by taking proper care of arc welding circuits.

90. ELECTRICAL CONNECTIONS—Erico Products Inc. Catalog includes seven sections of specific types of cable to other connections. Pictures, diagrams, specifications and prices are included.

91. X-RAY MICROSCOPE—Phillips Electronics, Inc. 6-page folder titled "A high resolution PMR X-ray microscope with electron microscope conversion" gives complete scientific details on instrument.

92. WELDING SCREENS—A. Mamaux & Co. Types and sizes of screens, stock sizes and specials made to order for any job application are included in folder.

93. V-BELT — Raybestos-Manhattan, Inc. 4-page color bulletin M210 describes new V-belt for long center, heavy duty drives.

94. RESISTANCE WELDERS—Alphil Spot Welder Mfg. Corp. Specifications, descriptions and applications of resistance welders specifically designed for the sheet metal, wrought iron and wire fabricating industries are given in catalog.

95. HYDRAULIC PRESS—Denison Engineering Div. Bulletin 195-A describes bench and floor model presses which range in capacity from 1-ton to 75-ton ram pressure.

96. ROCKET PRODUCTION—M. W. Kellogg Co. Brochure contains complete listing of the company's production facilities for missile and rocket programs.

97. ABRASIVES—Cratex Mfg. Co. Rubberized abrasives for deburring, smoothing and polishing applications are covered in catalog 228.

98. WORK GLOVES—Jomarc. Industrial fire-proof work gloves, mitts and sleeves are discussed in catalog 855-4308-20M-NAM. Pictures and prices are included.

99. ALUMINUM, MONEL INDEX — Whitehead Metal Products Co., Inc. Three-way index tells what is available from Whitehead. More than 12 alloys, and 50 forms are organized on 4x6-in. file cards.

100. TOOLING PLASTICS—Furane Plastics, Inc. Bulletin "Plastics tooling with Epocast," describes use of epoxy resins in such industries as metal trades, machine shop, etc.

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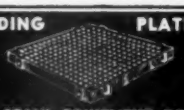

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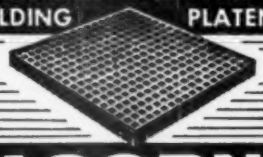

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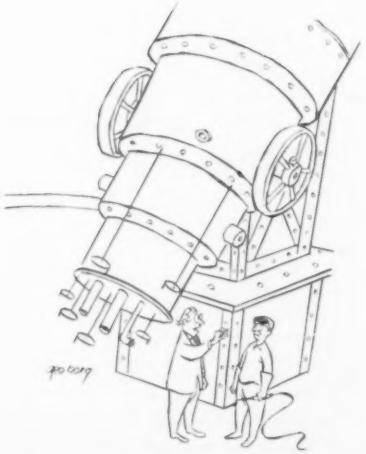

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"Sure you can have more money . . . who's offering it to you?"

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—George Borg

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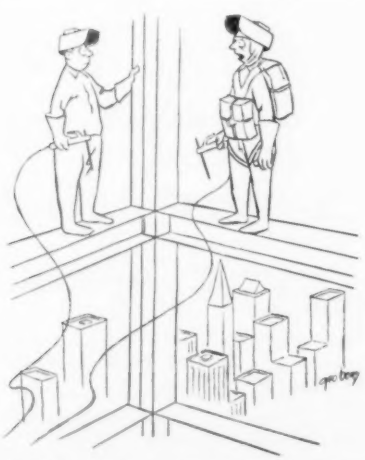

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143. Cullen-Friestedt Co.—Positioner catalog available on low cost welding.

144. Detroit Testing Machine Co.—More information available on the tensile testing machine.

145. Dockson Corp.—Catalog No. 5605 on Dockson's welding equipment and name of local distributor.

146. Duro Engineering Co.—Information on the standard holder and the "Durogon" holder available.

147. Drawalloy Corp.—Bulletin 355-DC provides complete information on every grade of Drawalloy welding wire.

148. Eisler Engineering Co., Inc.—For further information on Eisler's spot and wire butt welder and the vertical type press welder, write for catalog 93-57.

149. Electrons, Inc.—Write for further information on industrial thyratrons for automation.

150. Eutectic Welding Alloys Corp.—Write for help on any welding problem.

151. Federal Machine & Welder Co.—Information available on Federal's "Warco Packaged Production Lines" automated production from material to product.

152. Fibre-Metal Products Co.—Write for bulletin 65 on "Supergrip" Electrode holder.

153. General Electric Co.—Further information on the new portable x-ray "LX-140 is available.

154. H & M Pipe Beveling Machine Co.—Complete details on H & M machines available.

155. Harrisburg Steel Co.—Further information available on mobile gas storage cylinders.

156. Harris Calorific Co.—Data available on the 92-AR and 92-HE multi-stage metering regulators.

157. Hobart Brothers Co.—Catalog on Hobart's No. 413 welding electrode and welding machines.

158. Hobart Brothers Co.—Complete details on the "Budget 500" and other arc welders.

159. International Nickel Co., Inc.—Write for "Inco Welding Products" for requirements, applications, and specifications of Inco nickel alloys.

160. International Nickel Co., Inc.—Write for "Now You Can Weld Dissimilar Alloys Easily" for case histories on problem welds.

161. Jackson Products—Further information available on Jackson's safety equipment.

162. Johns-Manville Corp. — Brochure TX-2A explains the J-M "Aluminized Asbestos Cloth."

163. Lenco, Inc.—Further information available on Lenco's "Hi-Amp" ground clamps.

164. Lincoln Electric Co.—Further information on the "Mechanized Squirt Welder" is available.

165. Linde Co.—Write for further information on "Unionarc Welding"; electric welding method for steel.

166. Linde Co.—Booklet F-1174 available on "Oxweld" flame-cutting torches.

167. Liquid Carbonic—Illustrated litera-

(Continued on page 112)

WELDING INFO-AIDS

USE THIS CARD for Literature, Catalogs, and Bulletins shown on preceding pages and for those featured in this month's ads as listed opposite and on following page

Also information about

NEW PRODUCTS described on pages 78 to 92

Every month WELDING ENGINEER lists many new catalogs and bulletins available from manufacturers. All are yours for the asking. However, this service is valuable to you only if you use it.

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WARNING!

Illegible or incomplete addresses may keep you from receiving the information you desire. And remember, cards postmarked after the deadline date cannot be processed.

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Literature offered in ads

(Continued from page 110)

ture on "Liquidweld" products available.

168. Lummis Mfg. Co.—Write for catalog on "Key-Bak's."

169 Merrill Brothers—Further information available on material handling devices.

170. Messer Cutting Machines, Inc.—Write for information on Messer's line of precision cutting machines.

171. Metal & Thermit Corp.—Write for helpful hard surfacing data on convenient 3" x 5" file cards.

172. Metalloy Products Co. — Testing samples of "Galvalloy" available for your galvanizing job.

173. Miller Electric Mfg. Co. Inc.—Complete particulars on the new "Balanced Wave" electric control welder for tig welding.

174. National Carbide Co.—Information on calcium carbide and name of nearest distributor.

175. National Cylinder Gas — Bulletin N-142 describes the new NCG Electronic Line Tracer.

176. National Welding Equipment Co.—Catalog No. 16 on the new triplex oxygen regulator for three-hose flame cutting torches.

177. Norris-Thermador Corp. — Further information available on acetylene cylinders.

178. Norton Co.—Catalog No. 1748 available on Norton's reinforced wheels.

179. Page Steel & Wire Div.—A welding wire packaging chart and comparison chart are available.

180. Picker X-Ray Corp.—Further information available on any phase of radiation utilization.

181. Riegel Textile Corp.—Write for data on Riegel weldor gloves.

182. Ruemelin Mfg. Co.—Bulletin 37-E on Ruemelin's fume collector.

183. Shawinigan Products Corp.—Information on calcium carbide available and name of distributor.

184. A. O. Smith Corp.—Further information available on Smith's comprehensive line of electrodes.

185. Smith Welding Equipment Corp.—Information on "Flo-Trol" valves and repair service.

186. Stoody Co.—Write for information on iron powder build-up electrodes.

187. Stulz Sickles Co.—Details on "Manganal" wedge bars and nearest distributor.

188. Tempil Corp.—Sample pellets available; state temperature desired.

189. Tennessee Fabricating Co.—Catalog on 400 casting designs available.

190. Thermacote Co.—Write for complete descriptions of "Thermo" filter plates and cover lens.

191. Tuffaloy Dept. of Airco—Catalog and prices on spot-welding tips, holders and adapters.

192. Tweco Products, Inc.—Catalog available showing the complete line of Tweco accessories.

193. United Specialties, Inc.—Information on "Weldreel" hose and cable reels available.

194. Victor Equipment Co.—Write for information on Victor regulators and dealerships.

195. Victor Equipment Co. — Victor Hardfacing Manual shows you right rod to use and how to apply it.

196. Westinghouse Electric Corp.—Further information available on the new West-Ing-Arc Dynamic Reactor.

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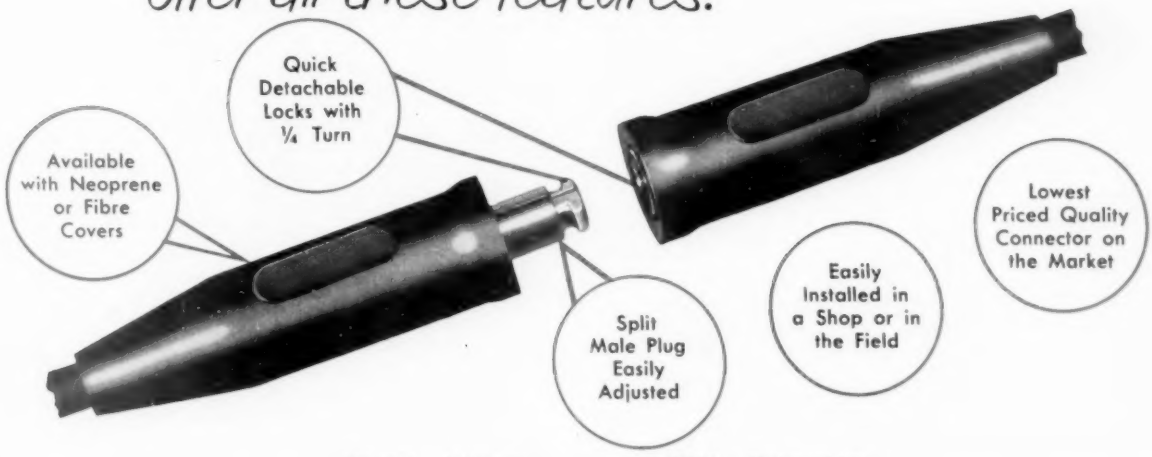
DOWN-TO-EARTH FACTS *about cable connectors*

Add On Cable — Take Off Cable
Use Shorter Cables — Save Wear
Save Welding Operator's Time
Remove Cable — Prevent Theft
For Quick Detachable Whip Cables
Splice Cable — Repair Cable

Only TWECO CABLE CONNECTORS *offer all these features:*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Split Male Plug Easily Adjusted
Easily Installed in a Shop or in the Field
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No rewelding possible...

Job for Inco-Weld "A"... the electrode that handles most problem joints...

and welds most dissimilar alloys, too

This weldor is fabricating a 12-foot high stainless steel reaction vessel designed to operate at more than 1200°F.

Insulating jacket prevents weld repairs...

In service, this vessel is entirely covered by an insulating jacket. Permanent welds are a must to prevent lengthy delays for repairs.

The root pass was made with a stainless steel electrode matching that of the vessel. But then the problem started. Toronto Coppersmithing engineers wanted to avoid heat treating the vessel after welding to remove weld brittleness. The welds had to be strong enough to withstand 1200°F. and be unusually ductile.

Inco-Weld "A" Electrode produces strong, sound, ductile welds

After a series of tests, they found Inco-Weld "A"* Electrode could be depended upon to produce the high quality welds needed without special procedures. What's more, the deposits made with this electrode have a coefficient of expansion close to that of the stainless steel – an important advantage when operating temperatures soar to 1200°F!

What's your joining problem?

Try a few tests with versatile Inco-Weld "A"† Electrode, the electrode with the distinctive green flux, for welding dissimilar alloy combinations, or Inco-Weld "A" Wire – the new inert-gas metal-arc wire just introduced. Both produce high quality welds between ferritic and austenitic stainless steel, low alloy and mild steel, high nickel and other alloys.

Get this new booklet

"Now You Can Weld Dissimilar Alloys Easily" includes case histories on problem welds solved and results on test data compiled on dissimilar alloy combinations. Send for your copy.

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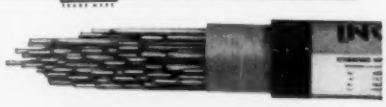
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